Pathological Researches.

ESSAY I.

ON MALFORMATIONS

OF THE

HUMAN HEART:

ILLUSTRATED BY NUMEROUS CASES, AND FIVE PLATES,
CONTAINING FOURTEEN FIGURES;

AND PRECEDED BY

SOME OBSERVATIONS ON THE METHOD OF IMPROVING THE
DIAGNOSTIC PART OF MEDICINE.

BY

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London:

PRINTED FOR LONGMAN, HURST, REES, ORME, AND BROWN,
PATERNOSTER-ROW.

1814.

Distinctionem morborum aliquando difficilem esse, fatentur omnes; possibilem autem in plerisque esse, fateri etiam oportet; nam, si quis hoc negaverit, idem fecerit, ac si nullam esse artem medicam dixisset.

CULLEN. SYNOPSIS NOSOLOGIÆ METHODICÆ.

J. M'CREERY, Printer,
Black-Horse-Court, Fleet-street, London.

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ADVERTISEMENT.

In investigating diseases by anatomy, the author chiefly proposes to contribute to the diagnostic part of medicine. The study of symptoms, without regard to the organic changes which gave rise to them, leads to a confused knowledge of the genera, species, and varieties of internal diseases. The Clinical Physician, who has never compared the morbid appearances with the corresponding histories of cases, can only offer a conjecture respecting the seat, and the kind of disease, under which a patient suffers. Very commonly, in giving his opinion of the case, he will content himself with saying, that his patient labours under some disease of the liver—some disease of the heart—some disease of the brain,—&c. This mode of expression is so familiar, that every medical man continually hears it, nay, often uses it. But if words be the signs of ideas, how loose and imperfect must be the conceptions of diseases, which, by the very expression, are thus rudely blended and confounded! What other than an empirical method of treatment can be founded on a diagnosis so purely conjectural!

The evidence on which the practice of medicine rests, is probable, and the reasoning is analogical. A learned writer

has well said, that "probable evidence is essentially distinguished from demonstrative, by this, that it admits of degrees, and of all varieties of them, from the highest moral certainty, to the lowest presumption." The presumptive evidence, on which Physicians are obliged to judge and to act, is, in many cases of internal disease, exceedingly small. Aware of the dangerous consequences of an error in judgment, they earnestly endeavour, by selecting diagnostic signs, to convert the low presumptions, of which I have spoken, into higher. In what manner this great end of their labour may be best accomplished, is one of the most important inquiries that can engage their attention. Every mode in which medicine can be studied, has its particular advantages; and in an inquiry which so essentially affects the comfort and happiness of mankind, our duty unquestionably is, to avail ourselves of every light which can lead us to the truth as it is in nature. We cannot commend, although we do not despise popular medicine. The wants of man, and his impatience to remove them, have always engrossed his attention; and he is instinctively led to regard, in the first place, those which he feels to be most urgent. Thus the popular inquiry extends not beyond what will cure a particular pain, a cough, a purging, and the like. This method, imperfect as it is, is not, in all cases, to be condemned, because the disease is sometimes so identified with the urgent symptom, that, by arresting the latter, the former is cured. It must be confessed too, that, by this mode of research, many valuable remedies have been added to the Materia Medica. But when medicine began to be studied as a science, the Physician perceived that, by merely attempting to suppress an urgent symptom, it often happened that he aggravated the disease. It was, probably, this difficulty which gave rise to the professional method of investigating disease, which we call Clinical medicine. Although its object is the same as the former, the method is far more rational, inasmuch as it regards not merely the symptom,

but seeks deeper into the causes, the kind, and the seat of the disease, with a view to the right application of the remedy. As our reasoning proceeds on the likeness of a case which we are observing, to cases which have already been observed, it is manifest that the value of the reasoning must depend on the correctness of the similitude; and the observer may be said to have acquired experience on the subject, when he has traced the likeness so often, that he cannot easily be deceived in forming his judgment of the case. But how imperfect is that experience which, if it can even reach the seat of the disease, contents itself with an indefinite idea of its kind; or, if it conjectures the kind, neither confirms, nor corrects the opinion, by observing the actual condition of the affected organ. The science of medicine does, indeed, rest on the basis of Observation; but that observation is of two kinds, Clinical and Anatomical. The former, in tracing the histories of cases, affords the opportunity of separating certain signs, which belong, in a peculiar manner, to the affections of certain organs. The latter, by displaying the particular morbid appearances which mark the seat and kind of the disease, connects, or endeavours to connect, the appearances with those signs by which they are characterized. I say, it endeavours to connect, for the labour is an arduous one, and does not always meet with its reward; but when it does not actually reach the truth, it affords the nearest approximation to the truth that we can obtain. It is by the researches of those that have preceded us, that the diagnosis of some internal diseases is now, nearly, if not quite, perfected. It is our duty, and the duty of those who follow us, to continue this valuable labour, although it is too probable that we shall never complete it. So desirable a result might be expected, if symptoms uniformly attended the morbid changes; since, however slight the sign, the repetition of it, from the very nature of probable evidence, would, at length, make that amount to a moral certainty, which was, at first, the barest presumption; but the signs,

which should denote some internal affections, are occasionally wanting. The errors, however, in diagnosis may, more frequently, be traced up to a hasty outline of the individual case, or to the insufficiency of former observations, and of the nosological character formed on them. Signs are either direct, or indirect and sympathetic. Of the direct signs we are far from having yet obtained perfect tables; and of the latter, the neglect has been still greater. These remarks apply to the characters of the diseases of most of the internal organs; but in an especial manner to those of the heart. When we consider the reciprocal influence which the sanguiferous and nervous systems have on each other, we cannot be surprized that the diseases of distant parts should be confounded with each other, or even that the centre of the one system, should sometimes be the supposed seat of a disease which actually affects the centre of the other. But although it be true that diseases even of the heart and of the brain, may be, and have been, mistaken, the one for the other, yet how much more frequently does it happen, that grosser errors in diagnosis are found in opinions given respecting diseases of the heart, the liver, and the stomach, in which those of the former have actually been treated for those of the latter, and vice versa. Whoever will take the pains to put to the test of anatomical observation, the opinions even of those who are accounted the best practitioners, will be forced to admit the necessity of extending our inquiries in this way, if we hope to improve the diagnostic part of medicine. Convinced of the utility of this labour, the author is desirous of adding to the common stock, the observations which he has been enabled to make. Before he undertakes to give those which have presented themselves to him on all the internal organs, he wishes to be permitted to communicate, in particular, what respects the heart, the alimentary canal, and the liver, in separate papers, carried on at the same time, for the convenience of referring to signs and morbid appearances, which have a relation to each other. The first number on the

Liver has already been published, and the second will shortly appear, the plates for it being finished. Instead of publishing the Diseases of the Heart in a series of numbers, it is proposed to give them in distinct essays. He pledges himself to complete what he has undertaken, as far as his health will permit, or the willingness of the medical public to bear a just proportion of the expense of so considerable an undertaking will justify him in doing; for, in performing his professional duties, he must not forget that he has others of a higher nature to fulfil.

The preceding observations are not offered as an apology for the inquiry into disease by anatomy—for, in truth, the subject needs none; but they necessarily arise out of the consideration of the best method of improving diagnosis. If it had been thought expedient to set forth the advantages which result from anatomical observation, it might have easily been shewn—1st, that this method, preceded by Clinical observation, affords the only means of distinguishing between diseases of function and diseases of structure, occurring in the viscera; and the most probable ground for the important opinion respecting the lapse of the former into the latter. 2dly, That it is capable of introducing great simplicity into the methodical arrangement of diseases, nosologists having exceedingly departed from nature in the multiplication of their species, and consequently of their genera; for, in tracing, by dissection, the morbid changes of internal organs, and on finding a very exact likeness between many of them, it is impossible not to perceive that numerous genera, at present received, are, in truth, but varieties in the stage, or in the seat, of one and the same disease. 3dly, That by rejecting the artificial forms, and studying only the natural or true species, it enables us to follow, with greater precision, their respective stages, to separate the characteristic from the anomalous signs which were noted in their histories, and, by thus establishing a more accurate diagnosis,

to adapt the treatment not merely to the name, but to the form and stage of the disease.

The Author, at a proper time, will resume this subject, and bestow on it that consideration which it merits. In the mean time, he may be allowed to hope that these observations will not be misunderstood. They are offered in relation to the science of medicine, and not to those who profess it. Each member of that learned body must conscientiously pursue the mode of inquiry which he believes to be best adapted to its improvement.

He feels no small degree of pleasure in acknowledging his obligations to gentlemen in every department of the profession for the opportunities which they have liberally afforded him of investigating diseases by anatomy, or for the communications of cases and dissections, with which they have favoured him. To his friend, Mr. Astley Cooper, he is more especially indebted, for encouragement and much assistance, during the last twenty-two years, in the study, first, of practical, and, lastly, of morbid anatomy. As no one has, more successfully than this gentleman, cultivated these important branches, or more happily applied them to the improvement of Surgery; so he has found no one more uniformly desirous of promoting the efforts of those who would, after the same example, contribute to the improvement of Medicine. By his late most valued friend and countryman, Dr. Jones, and his lamented friend, Mr. Saunders, he was considerably aided in these pursuits. He must also offer the tribute of his particular thanks to his early and respected instructor in medicine, Dr. Saunders; to his friends, Dr. Richards and Dr. Cutting, of Barbadoes, Dr. Bateman, Dr. Laird, Dr. Robinson, and Dr. Gooch;—to his friends and colleagues, Mr. Travers and Mr. Lawrence;—to his friends, Mr. Hodgson, Mr. Langstaff, Mr. Weston, Mr. Newington, Mr. Smartt, Mr. James Burrows,

Mr. Addington, Mr. Wright, Mr. Brougham, Mr. Spry, Mr. Baker, and Mr. Haynes. For opportunities of examining malformed hearts, or for communications on that subject, besides the assistance which several of his above-named friends have afforded him, he has pleasure in acknowledging the friendly attention of Mr. Young, Dr. Ramsbotham, Mr. English, Mr. Wheelwright, Mr. Leadam, and Mr. Saner. He feels not less grateful to those whom the delicacy which belongs to the inquiry may prevent him from naming, in describing their communications on other subjects than that of Malformation.

INTRODUCTION.

In this Essay nearly all the cases of Malformation of the Heart, which have been published, are concisely stated or referred to. The same plan will not be pursued on the respective subjects of the subsequent Essays. As the limited matter of the former admitted of it, it seemed desirable to collect the observations which have preceded those now communicated, that the desiderata might distinctly appear, and prevent future observers from contenting themselves with a mere repetition of the observations of their predecessors. Considerable progress, however, in respect to the diagnosis, has been made in the last five or six-and-thirty years. If a subject were now presented to us, who, from her *birth*, had had a violet coloured skin; whose lips, cheeks, and tongue, were almost black; whose eyes were prominent, and tunicæ conjunctivæ dark; who was affected with dyspnœa and cough, which were exceedingly aggravated even by the slightest exertion, and occasionally attended with symptoms of suffocation; whose pulse was weak and quick; whose stature was short, and whose limbs were slender and feeble:—from such a character, although her temperature were not taken into the account, we should now confidently affirm that her heart was malformed. But although a girl, having these symptoms, was observed by M. de Chamseru, in 1778, and formed the subject of a memoir, which is recorded in the Hist. de la Soc. Roy. de Med. Années, 1780 and 1781, yet he concluded that her complaint was only a species of icterus; whilst, by

another physician, spoken of by M. de Chamseru, two similar cases were supposed to be scurvy, and treated by an antiscorbutic regimen. Anatomical observation has now, indeed, enabled us to distinguish, with sufficient precision, the character which belongs to *ordinary* malformations of the heart. It has shewn us farther how to discriminate between it and an *approximation* to the same character, which occurs under a certain condition of the lungs, a point which we shall consider in its proper place. It has also taught us, that in particular cases of malformed hearts, although black blood should not be so much in excess as to give the characteristic colour of skin, the malformation may yet be discerned by the peculiarity of the respiration.

By affixing the title, Pathological Researches, to this and the following Essays, it is intended to express chiefly a purpose of tracing the diagnostic signs of the imperfect functions or structures of organs, and of endeavouring to discriminate between the conditions which admit of curative, and those which admit only of palliative means.—If some attention has been bestowed on a physiological subject in this Essay, it is due to its importance, and to the interest which that subject has excited.

The simple expressions of black and red blood have been preferred before the terms expressive of chemical opinions, which recent observations have not confirmed. The justly celebrated, but too unfortunate, Mr. Lavoisier, with a facility peculiar to himself, applied Dr. Priestley's discovery of oxygen to the most extensive purposes in chemical doctrine. He considered the red part of the blood as a true oxyd; and he is to be ranked as the first in the list of several distinguished chemists who have maintained, even from experiment, that, in respiration, a certain proportion of oxygen is continually *absorbed*. Other philosophers, however, were not wanting, whose experiments led to the opposite con-

clusion; that all the oxygen which disappeared was contained in the carbonic acid that was formed during respiration. If, after the publication of the well arranged facts, interesting experiments, and excellent reasoning, of Mr. Ellis,* it could have remained doubtful to which the truth appertained, the decisive experiments of Messrs. Allen and Pepys were calculated to convince us, that, in natural respiration, "the quantity of carbonic acid gas emitted, is exactly equal, bulk for bulk, to the oxygen consumed."

That the pulmonary circulation should be diminished to an *extreme* degree, and yet the internal surfaces of the body be capable of maintaining a temperature of 100°, or two degrees above the temperature of those persons in whom the due proportion of blood is circulated through the lungs, inevitably leads us to conclude, that there are other sources of heat to the body, besides that of respiration. That the skin should, in a degree, contribute to this important function, is no new opinion. Mr. Ellis, from a different series of observations, was impressed with the same notion; and he also refers to an eminent physiologist, and to a celebrated chemist, who taught the same doctrine.

The second species of Malformation of the Heart has been formed on authorities which the author respects; but he must also remark, that the same appearances may result from slow changes of structure. The evidence on which this opinion rests will appear in the second and third Essays; the former of which will treat of Pericarditis and Carditis; the latter of Chronic Carditis.

* See his "Inquiry into the Changes induced on Atmospheric Air by the Germination of Seeds, the Vegetation of Plants, and the Respiration of Animals."

ESSAY I.

ON

MALFORMATIONS OF THE HEART.

THE varieties of malformation of the heart, which take place in the human subject, shew us several degrees of imperfection in the function of that organ, by which our knowledge of the proper office of the lungs is improved. Indeed, the desire to inquire into the vital functions has been so strongly expressed by philosophers, that even detached facts, and single cases of malformation of the heart, have engaged the attention of some of the most eminent members of the medical profession; and have been deemed worthy of a place in the transactions of the most learned societies of this and other countries. For if the physiologist, in developing the vital functions of man, derive much instruction from inquiries of a similar kind in comparative anatomy, and from the analogical reasoning drawn from the facts thence obtained; doubtless, the reasoning must be more conclusive which rests on the varieties of malformation of the human heart. It must, however, be acknowledged, that, in this inquiry, the imperfections of structure have been traced with more diligence and accuracy than the histories of the cases; but, in future, to promote the physiological inquiry just hinted at, as well as to perfect the diagnosis, the latter will demand a more sedulous attention.

It was the opinion of an eminent writer on this subject, that malformations of the heart very rarely happened. As the period that has elapsed since this opinion was published is inconsiderable, it affords no mean proof of the rapid progress of anatomical inquiry, that the instances are now sufficiently numerous to create a difficulty in classing them.

A double heart, for the purpose of circulating all the blood through the lungs, before it is distributed to the body, being essential to the perfection of warm-blooded animals, the various parts of which it is composed admit of many species of malformation, if the imperfections of configuration be adopted as the ground of the classification; but as these imperfections of structure lead to only two errors in the function of the organ, each varying in degree according to the extent of the malformation, the following simple division into two species, the respective deviations from the natural structure under each being marked as varieties, may suffice.

I. Malformations of the Heart, or of its Arteries, mingling Black with Red Blood.

II. Malformations of the Heart, or of its Arteries, only impeding the Circulation of the Blood.

I. 1. *Single Heart.*

This variety may be said to be rare, as far as the observation of anatomists to the present period warrants that opinion. The unilocular heart in the human subject has been compared to that of amphibious animals; but the histories of the infants, whose hearts were thus formed, teach us, that the vital functions were less perfectly performed, or were soon extinguished. Far from acquiring the properties which belong to amphibious animals, they simply lost the advantages which result from the perfect structure of their kind.

I. 1. *a. Two Pulmonary Branches from the Aorta.*

E., a full sized infant, was born at three o'clock in the afternoon, March 30th, 1807. For the space of half an hour there seemed to be a difficulty in establishing the circulation through the lungs. His respiration was uneasy, and accumulated mucus in the larynx distressed him: his face was for some time very pallid, and afterwards slightly livid. Finally, the important functions of circulation and respiration were performed with freedom. During the first forty-eight hours, he seemed to enjoy the most perfect health: his countenance was lively and ruddy, his skin warm, the meconium and urine were properly evacuated; he took the breast eagerly, and slept easily. On the night of April 1st, his nurse consulted me for a difficulty in his breathing.

His respiration, indeed, was remarkably quick, but the temperature and aspect of his skin were natural, and he seemed to be free from pain. He was undressed to admit of a more particular examination. The action of the diaphragm was unusual, and at each contraction, which was very frequent, it forcibly bent inwards the margin of the thorax. The pulsations of the heart were too strong. Nothing was done, because the indications were not clear. He slept quietly the greater part of the night, but at an early hour the following morning, I was called to him. His cries expressed the distress he then suffered. The diaphragm laboured excessively, and the whole line of its attachment was marked by its vehement action; the heart thumped against the ribs; the pulse at the wrist could not be felt, the skin was pallid and cold. He was immersed in warm water until his cheeks flushed, and then wrapped in flannel. The circulation on the surface was restored, and his distress was mitigated. It appeared that his sufferings had been increased by a distention of the stomach; for after his mother's milk began to flow, at each time that he sucked, his distress became greater, especially the last time, which immediately preceded the violent exacerbation just described. After the use of the warm bath, his skin never became pallid as before, but remained somewhat cold, for the blood lingered in the cutaneous vessels, and his countenance was slightly livid. His muscular powers faded, and his limbs fell. Previous to the disturbed state of the respiration, his strength had been unusually great for that of an infant; but now he had not power even to embrace the nipple, although he would make the effort. The labour of the diaphragm ceased, his respiration became more and more feeble, his sensorium during the last few hours was torpid, but he died without convulsion. His death happened seventy-nine hours after birth, and about thirty after the respiration was affected.

Dissection.—The heart, situated naturally, was distended in the utmost degree with blood. Blood was extravasated under the pericardium, and very extensively into the cellular texture of the lungs, but there was no effusion into the cavities of the chest. The heart consisted of an auricle, a ventricle, and a single artery. The auricle was divided from its appendix more distinctly than it is in the natural structure, by an intermediate septum, which, however, gave a free passage to the blood through a large central aperture. The venæ cavæ opened into the auricle and the four pulmonary veins into the appendix. There was only one ostium ventriculi. The ventricle was single, and had a valve, which, although it was neither tricuspidal nor mitral, more nearly resembled the former than the latter. From the ventricle one artery, the aorta, furnished with semilunar valves, arose. Its two first branches were pulmonary, very large, and situated close to each other. The third branch was still larger: it came off at a right

angle from the aorta, and gave origin to the arteria innominata, the left carotid, and left subclavian arteries. It also sent down a single artery to the heart, which served instead of the coronary arteries. The continuation of the trunk had the usual appearance of the descending aorta. At the origin of the pulmonary branches, the aorta was considerably contracted in its diameter; its coats were separated by blood which had been extravasated between them from the vasa vasorum, and were also thickened; the inflammation extended along its internal coat towards the heart, and its valves were excessively red. All this was evidently recent, and probably caused by the increased current of blood through the pulmonary branches, the distention of which seemed to have impeded the circulation through the aorta, by making a kind of valvular process at its base. In consequence of such obstruction, too much blood was sent through the pulmonary branches, more was returned to the heart than it could eject, the artery inflamed at the obstructed part, the circulation was thus more and more impeded, till the cellular texture of the lungs was filled with blood, and the overloaded heart ceased to act.

The abdominal viscera were in a natural condition; the brain was not examined.

Fig. 1. Presents a posterior view of the veins, auricle, and ventricle of the single heart above described, with an outline of the artery, left lung, and bronchia.

a. a. The auricle. It is cut open, and its outer section pinned down to the ventricle; its inner section is stretched by two black pins, one of which, passing through the superior cava, pierces its inner membrane; whilst the other, partly concealed within the auricle, is fixed posteriorly, and just above it is seen the margin of the truncated inferior cava. Between these two pins there is an oval aperture which leads into the appendix. The ostium ventriculi is seen at the bottom of the auricle.

b. The superior vena cava with a black pin in it.

c. The inferior vena cava.

d. The opening into the appendix.

e. The ostium ventriculi.

f. The two right pulmonary veins, from the largest of which the head of a black pin projects.

g. g. The posterior part of the ventricle.

h. An outline of the posterior surface of the aorta.

i. Its right pulmonary branch, from which a white pin is seen projecting.

k. Its left pulmonary branch, pierced by another white pin which enters the inferior lobe of the lung.

l. Its third branch, from which the subclavian, carotid, and coronary arteries arise.

m. The descending aorta.

n. The bronchia.

o. An outline of the inferior, and a part of the superior lobe of the left lung.

Fig. 2.—*a.* That part of the auricle which is called the appendix, of which one entire surface is cut away to afford a distinct internal view of it.

b. The inferior vena cava, within the mouth of which is seen the valve of Eustachius.

c. The aperture from the auricle into the appendix. The imperfect septum between the former and the latter, somewhat resembles, in its figure, the valve of Eustachius.

d. The two right pulmonary veins. Into the largest of them a black pin is passed, which traverses the appendix, and pierces its serrated edge.

e. The trunk into which the two left pulmonary veins open. One of its surfaces is cut away.

f. An outline of a part of the ventricle.

g. A small outline of that part of the left lung at which the two left pulmonary veins enter the substance of the lung.

Fig. 3. Is an anterior view of the ventricle and artery, with the left lung in outline.

a. a. The ventricle cut open.

b. The ventricular valve, differing in its situation and figure, from either the tricuspidal or the mitral valve.

c. The aorta cut open.

d. Its right pulmonary branch: a white pin passed through this branch, is fixed in one of the semilunar valves.

e. Its left pulmonary branch, from which the head of a white pin projects.

f. f. Its third branch, from which the left subclavian, the left carotid, and the arteria innominata arise, and from which one coronary artery descends to the heart.

g. The descending aorta.

h. The superior vena cava, from which a black pin projects.

i. One of the bronchia.

k. An outline of the left lung, into which the two left pulmonary veins are entering. A part of its superior lobe had been cut off to shew its texture filled with blood.

I. 1. *b. One Pulmonary Branch from the Aorta.*

This heart, situated naturally, had one auricle with a narrow muscular band crossing the ostium ventriculi; one ventricle, separated from the auricle by tendinous valves, and one artery, the aorta, which sent off a branch in the situation of the ductus arteriosus. This branch divided into two arteries which were distributed to the lungs. The venæ cavæ and the four pulmonary veins, entered the auricle in their ordinary directions; but neither the areæ of the pulmonary veins, nor that of the vessel which acted as the pulmonary artery, exceeded half the common dimensions.

The child lived ten days, and had a blue colour of the skin; but it is stated, on the authority of Dr. Combe, that the respiration, temperature, and muscular action, were not materially affected. See the Phil. Trans. vol. xcv. p. 228; in which a particular account of this case is given by Mr. Standert. The heart is now preserved in the museum of Dr. Ramsbotham, to whose politeness I am indebted for an opportunity of seeing it. A figure of it accompanies the communication.

I. 1. *c. Heart transposed. The Aorta and Pulmonary Artery branching from a common Trunk.*

The heart, situated in the epigastric region, and imbedded in a cavity formed on the superior surface of the liver, consisted of a single auricle, ventricle, and arterial trunk, which soon divided into two large branches, the aorta and the pulmonary artery. The aorta, ascending, formed its arch as usual, and in the common place; the pulmonary artery divided into its two branches. The circumference of the former at its origin measured one inch and a quarter; of the latter, fifteen sixteenths of an inch. The bronchial arteries and veins were wanting. Two large pulmonary veins formed a trunk which joined the superior vena cava: a single vein, thus produced, terminated in the auricle, into the lower and back part of which the inferior vena cava also entered.

Symptoms.—The heat of the child to the feeling, for it was not tried by the thermometer, was in no respect different from that of other children; and the colour of the skin was perfectly natural, except that, on the day on which it was born, and a short period before its death, the lips had occasionally something of a livid appearance. The child sometimes cried, seemed weak and in pain, but sucked heartily, slept, and had proper evacuations of urine and fæces. It lived seven days, and died of inflammation of the heart, caused by some peculiarities in the monstrosity of the abdominal integuments;

for an account of which, as well as for a minute detail of all the circumstances of this extraordinary case, see Mr. Wilson's communication in vol. lxxxviii. of the Phil. Trans. It is illustrated by excellent figures.

A double heart, if its structure be perfect, prevents the admixture of black with red blood. The whole of the former is circulated from the right side of the heart, through the lungs, where it is changed into the latter; and being thus fitted for the purposes of life, it is returned to the left side of the heart, from whence it is circulated through the aorta and its branches, to nourish every part of the body. But in I. 1. the blood returning from the body and lungs being poured into one auricle, more completely mixed in the single ventricle, and from thence propelled into the common artery, it is obvious that the symptoms must vary in proportion to the size of the pulmonary branches which spring from that artery. The larger they are, the less will the blue colour of the skin be remarkable. In I. 1. *a.* and *c.* this sign was absent, but in *b.* it was present. In *a.* too much blood was sent to the lungs; in *b.* too little. In *a.* the laborious actions of the heart and diaphragm were the signs of an impeded circulation through the aorta; in *b.* the blueness of the skin was the sign of a diminished circulation through the lungs. Thus, if this inquiry were limited even to I. 1., blueness of the skin could not be admitted as the essential or diagnostic sign of this variety of malformation.

In explaining the absence of the blue colour in *a.* and *c.*, the areæ of their pulmonary vessels being nearly equal to the areæ of their aortæ, it is sufficient to say, that "as these arteries in the respective subjects were filled by the contraction of the same ventricle, the blood which passed to the lungs must have again been conveyed to the heart sooner, from the shortness of its circuit, than that blood which passed to, and was returned from the more remote parts of the body." But in *b.* the area of the pulmonary branch being greatly disproportioned to that of the aorta, it was impossible that the quick return could compensate for the diminished quantity of blood which was at any one time circulated through the lungs. In thus extending a part of Mr. Wilson's explanation of his case to others, I adopt only that which is demonstrative, and applicable to more cases than one. The larger surface of lung than usual, from the malposition of the heart, in *c.* is proved to be superfluous by *a.* since in both the blood was sufficiently red; and the supposition, in consequence of this circumstance, that a larger quantity of oxygen was combined with the blood, has been rendered more than questionable by the progress of physiological and chemical science. The theory of oxygenated blood, in the above sense, in which it was very generally received, has been ably controverted by the philosophical inquiries of Mr. Ellis into the changes induced on atmospheric air by the respiration of animals, published at Edinburgh in 1807. The results of the experiments of Messrs.

Allen and Pepys, on the same subject, published in the second part of the Phil. Trans. for 1808, also disprove the absorption of oxygen in the ordinary and natural state of respiration. It is true that they have come to an opposite conclusion, when by a forced and unnatural breathing the same air is respired as long as possible; but it does not follow, that, even under this distressed state of the respiration, the oxygen which disappears is absorbed; and it is probable that farther inquiry will explain results which are so contradictory.

I. 2. *Imperfect Double Heart.*

I. 2. *a. Unclosed Foramen Ovale.*

In considering the structure of the fœtal heart, the probability would seem great that the valve of the foramen ovale might frequently be imperfectly united to the annulus foraminis ovalis by the pressure to which it is subjected in the double circulation after birth. But yielding up probability to anatomical demonstration, an aperture of communication through the septum auricularum is actually so often met with in subjects brought into the dissecting rooms attached to the anatomical schools, that the observation of that student, who has not witnessed it, even in the adult, must have been exceedingly limited. But in these simple cases the communication is so oblique, that the valvular office must by this very arrangement be still performed, if not perfectly, at least so well as to prevent any perceptible disorder of the vital functions.

Mr. Astley Cooper has preserved a specimen of an unclosed foramen ovale with a well-defined margin. The opening in the right auricle is free, and even in the left it is large enough to admit a common writing quill; but the communication is very oblique. This preparation was taken from the heart of Mitchell, a man who suffered for murder a few years ago. He was in perfect health before his execution, and died in the usual manner.

Mr. Langstaff has also preserved a similar specimen, in which the communication between the auricles is somewhat oblique, but much more free and direct than in the case of Mitchell. The heart is of a natural size, and perfect in every other respect. The subject was a female whose age exceeded fifty. Mr. Langstaff had known her for many years, during which no symptom of malformation of the heart had ever appeared. She died of hepatic disease.

I might refer to other specimens from the adult, of which I have three in my own collection, for the fact illustrated by these cases is really very common. Several professors of anatomy with whom I have conversed have confirmed this fact, which was slightly noticed by Haller nearly seventy years ago.

The late Mr. Allan Burns, in his work on the diseases of the heart, declared that he had very frequently observed the foramen ovale pervious, even in very advanced age; and he had also not found it capable of producing signs of a deficiency of red blood, except under the circumstances which I shall presently notice. But he asserted that it is frequently productive of dyspnœa. To every thing which came from the pen of that gentleman I pay particular attention; but I do not deem the evidence on this point conclusive. Dyspnœa is really so frequent a disease in the adult, and an open foramen ovale so common, that they may be conjoined in the same individual, without the former being in any degree dependant on the latter. The probability of such a connexion is diminished by every instance of an open foramen ovale which was accompanied neither by asthma nor dyspnœa. Such were the cases here indiscriminately taken merely to illustrate the fact, that an open foramen ovale does not usually give signs of mingled black and red blood.

Led by these observations to seek farther information, it was not without surprise that I read the following introduction to this subject by the distinguished M. Corvisart:

"La perforation de la cloison des ventricules ou *des oreillettes* est aussi un des faits *rares* que *j'ai* rencontrés, et dont les observateurs ont donné quelques exemples. *Les deux* suivans *me sont propres.*" Pag. 276.

As the word la perforation, in respect to the imperfect septum ventriculorum is used in a sense somewhat different from that in which he here also applies it to the unclosed foramen ovale, it is proper to extract another passage in which his meaning is perfectly definite: "La perforation de la cloison des ventricules a quelque analogie avec la persistance (continuance) du trou ovale, dans l'homme déjà avancé en âge." Pag. 279.

Of the two rare facts which he himself had remarked, Obs. 43 describes a case of perforation of the septum ventriculorum, which I shall notice presently; and Obs. 44 contains a very interesting detail of the example of an open foramen ovale. I should have felt pleasure in inserting the history and dissection of this case, in the words of Mr. Corvisart, but for its length, and the consideration that his book ought to be in the hands of every medical man. As, however, I am led, by observations on the unclosed foramen ovale, to take a view of this case very different from that which Mr. Corvisart has taken, I shall briefly state, that a postillion, at the age of 57 years, received some violent blows on the epigastrium, which gave rise to symptoms of carditis. From these he had only imperfectly recovered, when a heavy weight fell upon the same part. To the former affection, now much aggravated, symptoms of pericarditis were superadded. Two years after his first accident, he was admitted under the care of Mr. Corvisart. One cannot

read the detail of his symptoms at that period without anticipating the fact of an impeded transmission of blood through the heart, especially through its left cavities, nor without discerning the increasing evidence of it through the rest of his history. It was not until the close of the fourth year after the first injury on the epigastrium, that the disease proved mortal. By dissection it was demonstrated, that the pericardium contained much serum, that the cavities of the right auricle and ventricle were excessively enlarged, and their parietes remarkably thickened; that the left auricle was thin and dilated, and the left ventricle very small. The right ostium ventriculi was so much dilated, that the extremities of four fingers united could easily be introduced into it; whilst the left ostium ventriculi (called by him, l'orifice auriculo-ventriculaire gauche,) being hard, whitish, and contracted, admitted the *extremity of only one* finger. The diameter of the pulmonary artery at the origin was great, but *of the aorta very small.* Lastly, the septum auricularum was so much stretched, that the fossa ovalis was two inches, and the foramen ovale more than one inch in diameter. The dilatation of the auricle and right ventricle, and most of the symptoms which preceded the death of the patient, are attributed by Mr. Corvisart to the open foramen ovale, or rather to its dilatation. When I consider the active service in which the life of this man had been passed, and that he had reached the age of fifty-seven years without any signs of malformation of the heart, I am led to conclude, that this case differed in no respect from those described at page 8, until inflammation, the effect of mechanical violence, by narrowing the left ostium ventriculi, had dilated the right cavities of the heart, and consequently the unclosed foramen ovale.

I. 2. *b. Dilated Foramen Ovale, or Imperfect Septum Auricularum.*

This variety of malformation, *uncombined* with others is rare. A physician has stated to me an instance of it, in which the patient, after having long suffered from dyspnœa and cough, died apoplectic at the age of forty years. The cavities of the heart were enormously dilated. The connexion between the malformation of the septum, and the dilatation of the cavities, does not seem to be necessary. Without insisting upon this point at present, I cannot enter farther into this variety, for want of facts, nor even dwell on the individual case, because it was committed only to memory. I am anxious to receive farther information respecting it. In such a malformation, which is essentially different from the merely unclosed foramen ovale (I. 2. *a.*), I do not question the probability of occasional dyspnœa, and of a more or less

permanent blueness of the skin, proportioned to the size of the aperture of communication between the auricles.

I. 2. *c.* *Dilated Foramen Ovale, with an Open Ductus Arteriosus.*

That the same heart should perform, with equal perfection, the circulation before and after birth, by an adaptation and subsequent change of structure, which fits it to these very different states of existence, is not the least remarkable amongst the many striking examples of design in the mechanism of animals, by which a rational creature delights to trace the omnipotent operations of his Creator. When it is considered, that the lungs, which are passive and useless in the fœtal state, perform, on the instant of birth, a function so vital, that every movement in the system presently stops if it be suspended—that the perfection of this function requires the obliteration not only of vessels which supply or change the blood of the fœtus, but also of two inlets, one giving passage from auricle to auricle, the other from artery to artery, which were essential to its economy, we cannot cease to admire the precision and uniformity with which these beautiful and important changes are accomplished. It has already been proved that the merely unclosed state of the foramen ovale (I. 2. *a.*) is not necessarily productive of an impeded circulation or mingled blood; but if to the unclosed foramen ovale, especially if its valve or the septum itself be malformed, be added an open ductus arteriosus, then the vital functions are disturbed in proportion to the dilatation of both these passages. A good case of this variety will be found in vol. vi. of the Memoirs of the Medical Society of London, described by Mr. Spry.

The foramen ovale was two inches in circumference, the ductus arteriosus was open, the auricles and ventricles were much dilated, the inner membrane of the heart was thicker and whiter than usual. This malformation happened in a female who lived seventeen years. Her symptoms were, a blue colour of the skin, dyspnœa, slight cough, palpitation, indolence, faintness on exertion, voracious appetite, throbbing pain of the head, great pain and weight of the left side. The pulse and temperature were not ascertained.

An interesting case of this variety fell under the observation of Mr. Allan Burns, from whose work on the diseases of the heart I shall give a concise report of it.

The circumference of the foramen ovale was equal to that of a goose-quill, of the ductus arteriosus to that of a large crow-quill. The thorax contained about a pound, and the pericardium about two ounces, of fluid. The subject of it was a male, who lived forty-two years. The signs of malformation appeared during his third year. Over-exertion was immediately

followed by spasmodic twitches of his muscles, urgent cough, fits of dyspnœa, and a slightly livid tint of the skin; but in the latter periods of his life, a permanently purplish and bloated countenance, oppression and anxiety, cold and clammy sweats, obscure pulse, anorexia, extreme debility, and general œdema, marked the more imperfect manner in which the vital functions were performed. The temperature of this patient is not expressly mentioned, but it may be inferred that it was not remarkably reduced, as he had always been able to follow the business of a painter. As the size of the heart and its vessels is not stated, I must conclude that it was natural. I also infer it from the moderate dilatation of the foramen ovale. If the inference be just, enlargement of the heart is not a necessary consequence of this variety of malformation, and the great dilatation of the auricles and ventricles in Mr. Spry's case must be attributed to some other cause.

On the 4th of November, 1813, Mr. English favoured me with an opportunity of examining a case of this malformation. We found the heart of its proper size and figure, its respective cavities being duly proportioned to each other; but the valve of the foramen ovale was so very imperfect, that a free communication between the auricles existed. The ductus arteriosus was open and larger than natural. The pulmonary artery was proportionally larger, but its right and left branches were of their proper size. The liquor pericardii was increased, the other cavities of the chest were free from serum, and the appearance of the lungs was natural. In the abdomen, we found the liver overcharged with blood, its gall bladder, cystic, hepatic, and common ducts, preternaturally contracted; but no other morbid appearance.

Mr. English put into my hands the following particulars, which he had noted previously to the examination. Mrs. S. was delivered of a girl, on the 15th of October, 1813. At her birth nothing very remarkable was observed. She cried faintly for a few minutes, seemed rather weak, and her skin and eyes were somewhat yellow. The bowels were freely opened by castor oil. An occasional threatening of suffocation when she sucked, unusual quietness, and perpetual drowsiness were remarked during the first week. In the course of the second week, she had fits of crying, generally in the evening, and her breathing was very remarkable. She would take a deep and long inspiration, sobbing once or twice during the time, and afterwards breathe very quick. Presently, the inspirations would be short, and the expirations uncommonly long, until she was roused with a sort of convulsive sob, attended with a slight crowing noise. This peculiarity in the respiration was manifested chiefly after sucking or crying. The paroxysm being over, she would fall asleep, and breathe easily, perhaps more quickly than natural, but start frequently. On the 14th night, the fit of crying was more severe than on any former occasion, and for several moments the breathing was sus-

pended, the lips becoming black, when a strong convulsive effort with a deep sigh restored animation. This took place repeatedly for about an hour, but afterwards the night was passed quietly. On the 15th and 16th days, the breathing became more and more disturbed; but the evening paroxysm of the 17th, was thought to be somewhat less violent than the preceding ones, and the night was passed more comfortably. On the 18th morning, the child took the breast with less suffocation than usual. The skin and eyes remaining very yellow, and the fæces deficient in bile, a grain of the submuriate of mercury, and four grains of rhubarb, were given at four o'clock in the afternoon. The child slept about an hour, awoke, and vomited a part of the powder, was soon afterwards apparently in much pain, and screamed violently. In this paroxysm, the breathing was frequently suspended for more than a minute, the lips were black, and the eyes fixed. A medical gentleman, in the neighbourhood, administered a dose of castor oil, some assafœtida, &c.; but, at eight o'clock, when Mr. English saw her, she appeared to be dying. The extremities were cold, the countenance cadaverous, the lips black, the breathing by short convulsive inspirations and long groaning expirations, with now and then a sigh. On putting her into a warm bath, it was surprising to see the improved state of the respiration; the expirations being assisted by gentle pressure on the abdomen and ribs. This treatment having been continued for half an hour, she was wrapped in warm flannel, and seemed to sleep for an hour, when the breathing gradually got worse, and all the former train of symptoms returned. The warm bath was again resorted to, with the same benefit as before; but, on taking the child out of the bath, she soon ceased to breathe if left to her own efforts. He therefore kept his hands constantly on the thorax and abdomen, and by assisting the expirations, prolonged her life for about two hours. For ten minutes together she sometimes lay without the least appearance of life, when a strong convulsive action of all the muscles of the thorax and abdomen, with a deep sigh, and several catching sobs, renewed the circulation. Then the colour would return to her lips; she would stretch her limbs, and open her eyes. The last struggle of this kind took place a quarter of an hour after he supposed that she was dead. He never could feel the pulsations of the heart, although he frequently examined the region of that organ. The pulsations of the radial arteries, he once observed, were synchronous.

I. 2. *d. Ostium Arteriæ Pulmonalis communicating with both Ventricles.*

This rare malformation has been observed only by Mr. Astley Cooper, to whom I am much indebted both for his kind assistance in enabling me to

procure histories of it, and for his permission to illustrate it by figures drawn from the specimens in his museum.

The first case occurred in a boy, born on the 12th of May, 1808. Mr. English, who attended his mother, and to whom I was referred by Mr. Cooper, most obligingly sent me the following particulars:

Mrs. C. has had twelve children, of whom only four now survive. The boy already mentioned lived nine days. A girl, born on the 19th of October, 1810, lived three months. A twin, born on the 24th of September, 1811, lived five days. Not only these; but other children of Mrs. C. had symptoms of malformation of the heart. The premature deaths of the boy and girl were ascertained by dissection to be owing to that cause. The little boy, whose case is the most remarkable, seemed to live in much misery. His respiration was exceedingly hurried; or, to speak more properly, he panted; his skin was always of a dark purple colour, and he died in convulsions. The warm bath afforded much relief, especially to the girl, who, by its frequent use for two months, gained flesh and grew considerably; but she was always remarkably still and inanimate.

Mr. Cooper made a note of the following particulars respecting the respiration of the boy, and the structure of his heart.

His breathing, for a minute, was regular, it then stopped with a deep sigh, the whole body was agitated, the heart fluttered violently, and again he breathed regularly. He had nine or ten shrieking fits before he died.

The sternum was more convex than usual, the heart large, its right ventricle more curved, thicker, and larger than natural. The pulmonary artery arose from the right ventricle, communicated with the left, and formed the aorta descendens, besides giving off its usual branches to the lungs. The aorta ascendens arose naturally, but passing upwards, it terminated in forming the arteria innominata, the left carotid, the left subclavian, and a very small branch, which was pervious only a part of its course to the descending aorta. See Fig. 4, 5, 6. The air cells of the lungs did not appear to be completely filled with air.

Fig. 4. *a.* The auricles.

b. The valve of the foramen ovale expanded, and imperfect. A portion of the right auricle has been cut away to show its size and figure.

c. The ventricles.

d. The ascending aorta.

e. The descending aorta. A small branch, nearly obliterated, passes from *d.* to *e.*

Fig. 5. *a. a.* The auricles.

b. b. The ventricles cut open.

c. The pulmonary artery cut open. A considerable aperture is seen at its

Fig. 4.

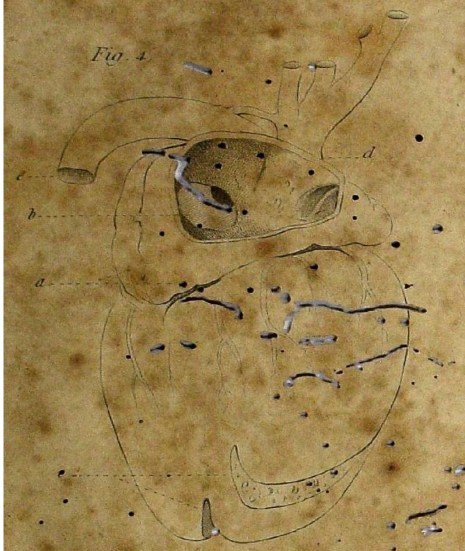


Fig. 5.

Fig. 6.

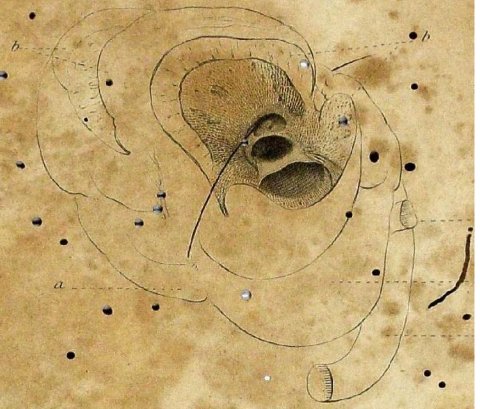
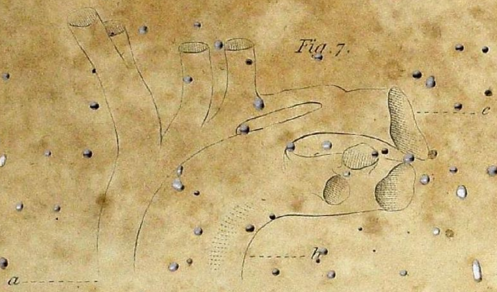


Fig. 7.



Published by Longman & C° Feb. 9. 1814.

entrance, through which a bristle is passed into the left ventricle. The mouths of the two pulmonary branches appear above this aperture. The rest of the artery forms the descending aorta.

d. The ascending aorta, dividing into the arteria innominata, the left carotid, and left subclavian, from the root of which the small branch passes to *e.*

e. The descending aorta.

Fig. 6. *a. a.* The auricles.

b. b. The ventricles cut open. In the left ventricle, the aperture communicating with the pulmonary artery, may be distinguished by the bristle which is passed through it. Next to that aperture is the mouth of the aorta, and beyond it the mitral outlet.

c. The left branch of the pulmonary artery.

e. The descending aorta continued from the pulmonary artery.

A second case occurred in Mrs. G's. son, born June 20th, 1809. During the first fortnight after his birth, she observed no difference between him and her other children; but after that period he breathed very quickly, and began to waste. On the first of August she consulted Mr. Cooper, who remarked that his respiration was three times quicker than it usually is in a healthy infant. He had no cough. The pulsations of the heart were strong and frequent, and there was much heaving of the chest. His skin was always extremely pale, and his hands and feet were cold; but with the exception of the lower extremities, she did not find it necessary to clothe him warmer than her other children. Œdematous swellings of the legs, and sometimes of the face, took place; his bowels were particularly costive, and he vomited occasionally. Although he fed well, he daily became more and more emaciated. She weaned him about two months before his death, and he seemed to improve for a fortnight; but after that period he again declined. She never saw the child smile but once; he was always fretful, and had a particular cry. At the age of eight months, he died suddenly, without convulsion, as she was taking him up to feed him.

Mr. Cooper examined the child after death. The chest was prominent and rounded. Each pleura contained about an ounce and a half, and the pericardium an ounce of serum. The heart was large and square. Its vessels were very large. The foramen ovale was dilated; the pulmonary artery was larger than the aorta, and arose from both ventricles, but chiefly from the right. The ascending aorta branched into the arteria innominata, the left carotid, and left subclavian arteries, and then dwindled into a small vessel, which terminated in the descending aorta. The latter arose as a branch of the pulmonary artery, in the situation of the ductus arteriosus, and

having received the branch from the ascending aorta, it gradually dilated to its proper size. See Fig. 7, 8, 9, 10.

Fig. 7. *a.* The ascending aorta.

b. The pulmonary artery.

c. The descending aorta, formed by a branch from *a.* and *b*

Fig. 8. *a.* The ascending aorta.

b. The pulmonary artery.

c. The descending aorta.

d. The right auricle freely opened to shew *e.*

e. The valve of the foramen ovale very much stretched, and imperfect at the anterior edge of the annulus foraminis ovalis.

Fig. 9. *a.* The right ventricle cut open. A bristle is passed into the mouth of the pulmonary artery, below which the tricuspidal outlet is seen.

Fig. 10. *c.* The left ventricle cut open. A bristle is passed into the communication which the pulmonary artery has with this cavity. By the side of it is seen the mouth of the aorta, and beyond it the mitral outlet.

Although the aorta ascendens and descendens appear in these cases to be distinct arteries, the aorta descendens being a continuation of the pulmonary artery, and being connected with the aorta ascendens only by a *small branch*; yet after the most deliberate examination and comparison with the variety I. 2. *c.*, I believe them to be actually the same. The *small branch* in Fig. 7. going from *a.* to *c.* seems to be the contracted, and in Fig. 4. going from *d.* to *e.* the nearly obliterated trunk of the aorta. The law, which regulates the dilatation of small arteries, when the primary and larger channels are impeded, or quite obstructed, and of which so beautiful and important an application has been made by the illustrious John Hunter, will shew us why under such circumstances the ductus arteriosus should become so much dilated as to be identified with the aorta descendens. This view of the subject led me to place this variety next to I. 2. *c.* and to mark the opening of the pulmonary artery into both ventricles, as the only fact which constitutes the essential difference between them.

I. 2. *e. Dilated Foramen Ovale and Contracted Ostium Arteriæ Pulmonalis.*

The best example of this malformation will be found in the XVIIth Letter of Morgagni, Art. 12, 13. The symptoms accurately corresponded with the appearances on dissection. The case is related with the utmost simplicity, and the explanation of it, as far as he has entered into it, is satisfactory. The subject of it was a female, whose skin was universally of a

Fig. 8.

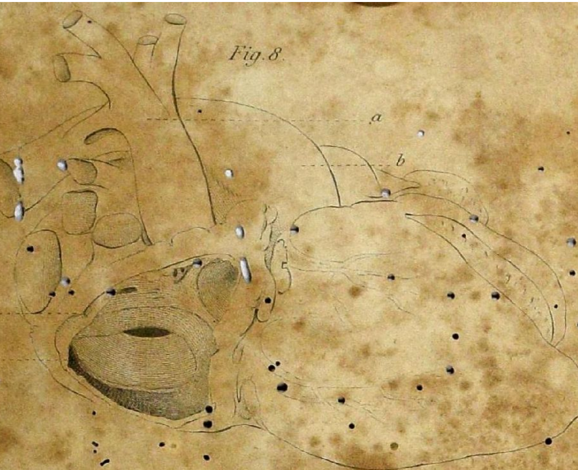


Fig. 9.

Fig. 10.

Published by Longman & C°. Feb. 9. 1811.

livid colour; and who, from her birth, had always lain sick, suffering great debility and shortness of breath. She died at the age of sixteen years. The heart, small in size, was altered in its figure, the apex being rounded, and the right ventricle, although wider, being thicker in its parietes than the left—thus the right ventricle had the form of the left, and vice versa. The right auricle was also twice as thick and large as the left. The foramen ovale was open enough to admit a little finger. The tricuspidal valve was imperfectly formed. The semilunar valves of the pulmonary artery, slightly ossified at their upper edges, were there so connected as to leave a very small aperture for the passage of the blood. At this opening, some fleshy and membranous productions were so situated, as to supply the place of valves. The narrow entrance of the pulmonary artery at once explains the symptoms which were observed, and the peculiar figure of the heart. The temperature of her body did not engage the attention of Morgagni.

Another case of this variety, was published by Tacconi, in the sixth vol. of the Commentaries of the Academy of Sciences, at Bologna, and is translated in the sixth vol. of the London Medical Journal.

The foramen ovale was open and larger than it usually is in the fœtus. The pulmonary artery was so much narrowed by the adhesion of the semilunar valves to each other, that only a very small opening remained. The ductus arteriosus was closed; the figure of the heart was rather cubical than conical, from the altered shape and structure of its ventricles, the left having the appearance of the right, and vice versa.

The subject of this malformation was a female, who, at the age of fifteen, first attracted the attention of the author by her manner and appearance. She walked slowly, and seemingly with great difficulty, and used to stop a little at every third step; her arms, hands, lips, face, and tunicæ conjunctivæ, were of a livid colour; she felt a constant pulsation in the left side of her chest, and extreme weakness in all her limbs; she had a quick, weak pulse; a respiration conducted without any sensible effort of the thoracic and abdominal muscles; a low, faltering voice; an impeded deglutition, so that even thin or liquid aliment could not be swallowed without much difficulty; she had not menstruated, and was generally costive. To add to the misery of this poor girl she was a beggar; so that we need not doubt the accuracy of her remark to Tacconi, that her complaints were constantly much increased during the winter. For three years her complaints gradually became more distressing; and, at the end of that period, in the winter-season, when the weather was unusually cold and wet, she began to complain of a pain in her left side, and to discharge, by the mouth, a black grumous blood. Still she continued to place herself in the street as usual, until, on the twenty-fourth day after these last symptoms, she was obliged to be car-

ried home, where she soon died. The first symptoms (by the girl's account) were observed when she was five years old, and she naturally enough attributed them to a severe fall which she suffered at that time; but it is remarkable that this circumstance, so inadequate to explain a structure of the heart, which must evidently be referred to malformation, should have been deemed so important as to have the chief place in the title of the communication, recorded in the Commentaries of the Bolognian Academy: —De morbo, qui lapsum ab excelso loco, et inde ortum terrorem consecutus est. In this case, the undisturbed state of the breathing does not accord with the morbid appearances. The author, however, expresses himself strongly on this point. During the space of three years from the time he first spoke to her, hardly a day passed without his seeing or conversing with her; and yet, during the whole of that period, though he observed her with the greatest attention, he could never discover that her nostrils, thorax, or abdomen, had the least degree of motion in respiration. In examining the body, besides the malformation of the heart already noticed, he reported that the capacity of the thorax was extremely small, the lungs dry, hard, and contracted, the left lobe livid, and adherent to the pleura, where she had complained of pain; about three ounces of grumous blood were found in the trachea, and on the surface of the diaphragm, which was much pressed upwards by the abdominal viscera; the liver, stomach, and omentum, appeared larger than usual. This case is sufficiently intricate, without admitting the supposition of the author, that the very small opening into the pulmonary artery had been made by the probe with which he had examined the state of the semilunar valves of that artery; for a closed pulmonary artery, without the compensation of an open ductus arteriosus, or a pulmonary branch from the aorta, would, indeed, overturn all our notions on this important part of physiology. I regret that the state of the bronchial arteries is not reported. On this obscure case the next variety will throw some light.

I. 2. *f. Dilated Foramen Ovale, with an Open Ductus Arteriosus, and Impervious Ostium Arteriæ Pulmonalis.*

This variety of malformation, if it be considered in relation to those which have been already described, may be called frequent. The following description, with some deviations too trivial to constitute a distinct variety, embraces several cases of it.

The venæ cavæ enter as usual into the right auricle, which communicates with the left by a dilated foramen ovale. The right ostium ventriculi is formed; but the reduplication of the internal membrane of the auricle,

which, being extended from the ostium ventriculi, should hang within the ventricle, is unfinished; the beginning of it, termed annulus valvulosus, exists; but, from this ring, the treble productions, called valvula tricuspis, and also the chordæ tendineæ and carneæ columnæ are wanting. Here, too, ends what there is of a right ventricle: nearly the whole of that space which it should occupy is filled by muscular fibres. The ostium arteriæ pulmonalis is closed; but from that impervious point the pulmonary artery is continued, and communicates with the aorta by the ductus arteriosus. The pulmonary veins open as usual into the left auricle. The left ostium ventriculi, the valvula mitralis, the ostium aortæ, and valvulæ semilunares, are perfect. Dr. William Hunter published a case of this variety in the Medical Observations and Inquiries. (see vol. vi. p. 291) In the course of ten minutes after birth, he found the infant's skin every where very black, his breathing laborious, and the motion of his heart so violent, that it could be seen outwardly, from a considerable distance, keeping up a constant and violent movement of the præcordia. The infant, finally, had repeated convulsions, and the vital functions ceased on the thirteenth day. It is singular that so excellent a teacher has not left us any observation on the temperature of this infant.

In the 5th vol. and 19th No. of the London Medical Review, there is a short report of a case of this variety of malformation. Mr. Hodgson kindly allowed me to examine the preparation, which corresponds with the anatomical character of this variety, in respect to the imperfect formation of the right ventricle, but has the following peculiarities. The foramen ovale is not merely open, but its valve is very imperfect; so that there is a very large aperture of communication between the auricles. In the septum ventriculorum some of the muscular fibres are wanting, and the lining membrane of the left ventricle has three foramina, giving it a cribriform appearance. In the place of the pulmonary artery there is an impervious filament, leading to a very large ductus arteriosus, which may be traced from the aorta into two pulmonary branches. The trunk is much larger than an ordinary ductus arteriosus, but is smaller than a pulmonary artery. A deep purple colour of the skin was observed soon after birth, attended with difficulty of breathing and convulsions; but the heat of the body, it is said, was not below the natural standard. The infant died on the seventh day.

Two very fine specimens of this variety are preserved in the Museum of Mr. Langstaff, who kindly informed me, that he had met with one of them in a still-born infant; but that the other had been taken from a child, who lived six months, whose temperature was much below the natural standard, whose skin was of a dark purple colour, approaching to black, and who had fits daily. The deviation, in this case, from the anatomical character above given, consisted in a remarkably short and very small ductus arteriosus, and

in a considerable perforation of the septum ventriculorum. The latter was nearly closed by the fibres, which almost filled up the right ventricle. I have been allowed to examine a fifth specimen; and a sixth has been reported to me.

I. 2. g. *Perforation of the Septum Ventriculorum.*

This variety of malformation was first described by Dr. W. Hunter. He observed it in a fœtus still-born at six months. In the septum ventriculorum, at the basis of the heart, there was a hole, offering a ready passage to a goose-quill, from either ventricle to the other. *The edge of the hole all round was smooth*; so that it plainly appeared to have existed from the first formation. In this heart the valve of the foramen ovale was very thin, and cribriform.

Mr. Corvisart met with an example of it in a boy, who lived twelve years and six months. There was a round hole in the septum ventriculorum, near the origin of the pulmonary artery, large enough to admit the end of a little finger, and *its edges were every where smooth and whitish.* This hole opened into the cavity of the left ventricle, just below one of the semilunar valves of the aorta, which was partly destroyed, so as to be incapable of performing its office. To the destruction of this valve, rather than to the malformation of the septum, should be attributed the excessive enlargement of the heart, and some of the following symptoms: a bloated face and violet-coloured lips, a peculiarly constrained respiration, an irregular beating and remarkable rustling; a small, feeble, but regular pulse, frequent palpitations coming by paroxysms, and impending suffocation. He was incapable of lying down, but was somewhat relieved by sitting, and still more so by inclining forward.

Mr. Corvisart is undecided whether this be a case of malformation or organic disease of the heart. A comparison of it with Dr. Hunter's case, and with some of the following, leave no doubt in my mind, that the hole in the septum is to be referred to malformation. The unsupported state of one of the semilunar valves of the aorta, from this deficiency of the septum, probably occasioned its destruction by ulceration, which seems to have been a more recent event. On this account, I am disposed to think that the boy was not so inaccurate in stating that his complaint (the urgent and afflicting part of it) had existed only five months.

I. 2. *h. Ostium Aortæ communicating with both Ventricles.*

The learned Professor of Anatomy, Sandifort, observed and described this variety of malformation. He viewed it with astonishment; but the progress of inquiry compels us to declare, that of all the malformations of the heart this is by far the most frequent. It is pretty constantly combined with one or several of the preceding varieties. In the case related by Professor Sandifort, the foramen ovale was unclosed, the pulmonary artery was remarkably contracted, the right auricle and ventricle were much dilated, and the lungs were small and compressed. The child lived twelve years. The symptoms were modified by the contraction of the pulmonary artery, and the dilatation of the right cavities of the heart. His dyspnœa was greatly aggravated by motion, during which, the countenance became livid, the eyes protuberant and suffused, the face too full, and pulsations were visible in the neck. At all seasons chilly, he shivered in the winter, even although seated close by the fire. Hemorrhage from the nose occasionally occurred, and relieved him. The symptoms were not manifest till the beginning of his second year.

Twenty years ago, Mr. Abernethy, in his Surgical and Physiological Essays, described and illustrated by engravings, a case of this variety, which, in respect to structure, differed from Professor Sandifort's case chiefly in the greater size of the foramen ovale, and in the ostium aortæ being seated completely within the right ventricle, instead of arising over the septum ventriculorum, which is more usual in this malformation; but corresponded with it in the essential circumstances of the remarkable contraction of the pulmonary artery, the increased capacity of the aorta, the dilatation of the right auricle and ventricle; and in both ventricles (the left by means of an opening in the upper part of the septum ventriculorum) projecting their blood into the aorta. This child lived two years; his skin was unusually blue, and habitually cold, his respiration was irregular by paroxysms, during which, a horizontal posture with his face downward was preferred by him.

Thirty years have elapsed since Dr. Hunter, in the sixth volume of the Medical Observations and Inquiries, communicated a case which must be referred to this variety. The pulmonary artery was so much contracted at its origin from the right ventricle as barely to give passage to a small probe. There was a perforation at the basis of the heart, large enough to allow his thumb to pass across from either ventricle to the other, the orifice of the aorta being situated so close to this perforation, as, in the action of the heart, to receive the blood from the right ventricle as well as from the left. This youth lived to the age of thirteen years. His figure was remarkably slender

and delicate: his complexion always dark, or tending to black. The most distressing symptoms occurred in paroxysms, which varied in their violence and frequency, but were generally more severe when he was in town than in the country. He grew oppressed at his heart, became weak or faint, grew dark in his colour, and, at last, almost black, fell down, and seemed insensible. He commonly soon came out of the fit, with sobbing and yawning, and a sense of fatigue. Any hurry of mind, or brisk motion of body, would generally occasion a paroxysm, which he had been taught by experience altogether to prevent, or, at least, to diminish its violence, by instantly lying down upon the carpet, on his left side, and remaining immovable in that position for about ten minutes. Dr. Hunter saw this experiment made with success.

Dr. Richard Pulteney, in the third volume of the Medical Transactions, published by the London College of Physicians (1785), communicated a case which must also be referred to this variety of malformation. The ostium arteriæ pulmonalis was much smaller and firmer than usual. It is farther stated, that on an examination of the ventricles and aorta, a canal was found communicating with both the ventricles, situated, in an oblique direction, near the basis of the heart, and so capacious as to admit the end of a finger to be passed from the aorta, with equal facility, into either ventricle, the septum of the ventricles appearing to terminate with this canal, which was totally unfurnished with any thing like valves, and was in every part perfectly smooth. This description is not quite clear; but the conception of the case which I form from it, is that of an aorta arising directly over an imperfect, or perforated, septum ventriculorum. The *heart* was firm in its texture, and of a *natural* size; but the *left auricle* was observed to be *very small*. Haller sometimes used the words *heart* and *ventricles* as synonymous terms: thus, ostium *cordis*, ostium *ventriculi*, are used indifferently by him to express the same thing. Dr. Pulteney must here be supposed to follow, in his expression, that illustrious physiologist. The external appearance of the body was the reverse of Dr. Hunter's case, the cellular membrane being extremely loaded with fat. This young gentleman had been uniformly subject to a sense of oppression and faintness, as well as to difficulty of breathing, after every muscular exertion. These symptoms gradually increased; so that, at length, he frequently could not walk across a room without turning almost black in the face and hands, and becoming, at the same time, faint and almost breathless. At the age of thirteen years and nine months he died of a dysentery, with which he was seized on coming off a journey.

Mr. Allan Burns referred to a preparation of this variety of malformation, which is now in the possession of Dr. Jeffray, and was obtained by Dr.

Nevin. Mr. Burns, in marking this as his first species, noticed only the cases observed by Professor Sandifort and Dr. Nevin. In both these instances, said he, the person led a most miserable life, and was subject on every trivial exertion to those paroxysms which are produced by a mixture of the venous with the arterial blood, and at length died with dropsical symptoms. But serous effusion into the cellular membrane or cavities does not in these cases result from the mere mixture of black with red blood; nor does it take place at all, unless the configuration of the heart, or of its vessels, impedes the circulation of the blood.

Mr. Corvisart, besides referring to the case of this variety, published in Dr. Duncan's Medical Commentaries, the subject of which lived ten months, has re-published two other cases from the memoir of Professor Caillot. In the first, the heart was enlarged and gorged with blood, the foramen ovale unclosed, the septum ventriculorum largely perforated, and the aorta, situated over the aperture in the septum, communicated with both ventricles. The pulmonary artery, much contracted at its mouth, and more so above it, had but two semilunar valves, and the ductus arteriosus was completely obliterated. The child lived eleven years, subject from his earliest infancy to a bluish tint of his skin; and from the age of sixteen months to convulsive motions and faintings, which were usually excited by some effort, or violent passion, during which, the skin changed to a violet colour, or even became quite livid, and he appeared to be suffocated. He was very sensible of cold, and was much oppressed by the slightest exercise. At the age of five years he had a nasal hemorrhage, which was not easily suppressed.

In the second case, the heart was situated transversely in the chest; the right auricle, distended with blood, was as large as the rest of the heart; the foramen ovale was open enough to admit a female sound, the right ventricle was contracted, and its parietes were much thickened; the contraction of the ostium arteriæ pulmonalis was so great that only a stylet could be passed into it; the aorta arose over an aperture of communication between the ventricles; the ductus arteriosus was obliterated.

This case bears, in most points, a close analogy to the first; but exceeds it in degree. The symptoms were proportionally more urgent, and the boy did not reach the age of the former by many years. He was subject to excessive dyspnœa, to faintings, and general lividness (although sometimes the skin was remarkably pale during the paroxysms); his growth had been very much impeded; he was very weak and thin, and always kept his bed; his face was of a red violet colour; his gums were swollen, and easily bled; profuse hemorrhages and coma closed his life. His parents may be excused for tracing his symptoms to hooping-cough, which attacked him when he was two months old; but it was not without surprise that I read the following passage,

expressing Mr. Corvisart's opinion on this subject: "Remarquons enfin avant de terminer cet article, sur lequel il y aurait beaucoup encore à dire, que l'on peut regarder la rupture de l'espèce de membrane qui tend à oblitérer le trou ovale, ou plutôt peut-être son décollement par un effort considérable, comme une des causes accidentelles de cette maladie; tel est le cas de l'enfant chez qui cette maladie parut à la suite d'une violente coqueluche."—I have already ventured to differ in opinion with Mr. Corvisart respecting the evils which he judged to be consequent on the merely unclosed foramen ovale. In this instance, he dwells on the *supposed* rupture, or separation of the valve of the foramen ovale, although the several other deviations from the natural structure were far more important, and sufficient to explain the urgent symptoms. Besides it is now unnecessary to have recourse to conjecture, when we have the positive evidence of so many cases in which the unclosed or even dilated state of the foramen ovale has accompanied this variety of malformation.

Mr. Astley Cooper has preserved in his museum several specimens of this variety, one of the most remarkable of which he kindly permitted me to represent, by Fig. 12. It relates to the case of John Cannon, for whose history I am indebted to Mr. Wheelwright. At his birth nothing unusual was observed, but after a few months his mother thought that he was of a darker complexion than her other children. At the age of two years and a half, she distinctly recollected, that the bluish black colour of his cheeks and lips (to use her own words) was heightened by passions of the mind, and by cold. From this period until his death, he was always similarly affected, not only by mental, but even by slight corporeal exertion, particularly in very cold weather. At all times his hands and feet, and even the surface of his body, were cold to the touch. Before he was three years old, he lost the use of his lower extremities; but in a few weeks, under the care of Dr. Babington, he recovered their use and his former state of health. At the earliest period that he was able to express his feelings, he complained of frequent nausea, and severe head-ach. These symptoms were brought on or increased by the causes above enumerated, and were established at the age of five years. Latterly, from the least exertion, he seemed to suffer much, manifesting it by putting his hand to his head, and by an increase of the nausea. His bowels were generally regular, and never confined. About this time, Mr. Astley Cooper, Mr. George Young, and many other medical men were consulted on his case. On the 15th of October 1812, being then nine years and five months old, he was taken to Mr. Wheelwright, for a loss of the use of his left thumb. His habit was spare and delicate, but his health being in its usual state, and no injury apparent, only an aperient powder was given to him. On the 17th he suffered a paralysis of the left

Fig. 11.

Fig. 12.

arm and leg, with partial convulsions of short duration, severe pain of his head, *great heat of skin*, furred tongue, and frequent nausea: the pupils were somewhat dilated, and his pulse was 120. From these symptoms, and his previous history, only the most unfavourable opinion could be formed; but yielding to the desire of his friends, who were solicitous for his relief, Mr. Wheelwright ordered leeches to his temples, a blister to his neck, a dose of calomel, and a solution of sulphate of magnesia [illegible] taken. 18th. Pulse 124, tremulous and irregular, convulsions in[illegible]d in violence and duration. Medicines operated three times: the [illegible] dark coloured and very offensive, urine high-coloured and scanty. [illegible] Pulse 86, feeble and irregular, nearly alike in both arms, his powers [illegible]lly sinking, his body covered with a moist and warm perspiration. 20th. [illegible]se from 66 to 70, very feeble and tremulous, pupils much dilated. In [illegible] evening he expired. About six or seven days previous to his death he [illegible] whilst at play with a schoolfellow, and struck his head on the ground: a [illegible]cumstance which was not mentioned before his death.

Upon dissection, an abscess was found in the right hemisphere of the [illegible]rain, which contained about an ounce and a half of a thick, dark-coloured, [illegible]nd extremely offensive pus.

In the heart there was an aperture of communication through the septum of the ventricles at the root of the aorta. The semilunar valves of the pulmonary artery were contracted into a small circle. The ductus arteriosus was closed. The aorta then, in this child, in effect, arose from both ventricles of the heart, owing to the deficiency of the septum at the root of that vessel, and the pulmonary artery could convey but little blood to the lungs, from the strictured state of its valves.

In this case we notice two distinct trains of symptoms, one characterizing malformation of the heart, the other inflammation of the brain. Although there was early evidence of a suffering brain, it cannot be clearly traced to the diminished area of the ostium arteriæ pulmonalis, and to its effects on the circulation through the brain. In some of the preceding cases, the pulmonary circulation was much farther diminished without this result. The most remarkable circumstance in the malformation is found in the valves of the pulmonary artery, which consist of only two membranous productions, so united as to leave a small circular aperture. This, according to our present experience, is rare. It has been once observed by Professor Caillot. See his first case.

Fig. 12. *a.* The pulmonary artery cut open. It is much contracted, and its entrance is rendered narrower by the malformation of its valves.

b. Its two semilunar valves so united as to form a circular orifice. The figure faithfully represents its size.

c. The perforation of the septum ventriculorum.

d. The aorta. A blow-pipe, introduced into it, is seen in the right ventricle: a portion of the ostium aortæ may be traced into the left ventricle, behind the perforation in the septum. This figure distinctly shews the defect of structure by which the blood from both ventricles was delivered into the aorta.

In another of Mr. Cooper's specimens, besides the communication of the aorta with both ventricles, and the contraction of the ostium arteriæ pulmonalis, the septum auricularum is wanting. Into each auricle a superior vena cava enters, and into the left auricle the inferior cava. Each auricle has its perfect appendix. This case has been described by Mr. Ring, in vol. xiii. p. 120, of the Medical and Physical Journal. The subject was a female infant, who lived exactly a year. Her complexion was more or less blue, and her breathing very difficult. Twice every day, for several hours, she had paroxysms of screaming, which gradually became longer and more violent. She was emaciated in an extraordinary degree, and for the last fortnight of her life, ceased to take notice of any thing. Her temperature is not mentioned.

Mr. Lawrence, amongst other specimens of this variety in the museum of St. Bartholomew's, did me the favour to shew me the following very curious example of it. The septum auricularum is perfect, and the foramen ovale is closed. The right and left ventricles are equal in muscular substance, and the valves are natural. The aorta, of its proper size, arises over the septum ventriculorum, so that it opens equally into both ventricles. Two apertures in the right ventricle communicate with a very small *third* ventricle, from which the pulmonary artery, *correctly formed*, and of *its usual size*, arises. From the appearance of the heart, I think that the age of the subject exceeded fourteen years.

In all the preceding examples of the aorta communicating with both ventricles, we have noticed either a contracted or an obliterated pulmonary artery; but in the last instance, this artery was of its proper size—an important circumstance; to which, in every variety of malformation of the heart, the attention of inquirers is requested.

A respectable surgeon, two years ago, kindly brought, for my inspection, the malformed heart of an adult. Although the aorta arose from both ventricles, he lived to the age of forty years or upwards. I certainly should have solicited that gentleman's permission to make notes of the symptoms and appearances, if I had not understood that the case was to have been immediately published. A review of the several cases of this variety, here related, collected, or referred to, convinces us that there must have existed some difference in the structure, by which life was, in this instance, so much longer preserved. This difference, if I may venture to state it from

memory, depended on the greater size of the pulmonary artery. I hope hereafter to obtain an exact account of this case.

If I had been more industrious, it is probable that I might have added to the facts which are offered in proof of its occurring more frequently than any other variety of malformation of the heart. Even in the last number of the Edinburgh Medical and Surgical Journal, Mr. Howship has given a case of it, combined with an open foramen ovale and ductus arteriosus, an obliterated ostium arteriæ pulmonalis, an aorta enlarged and more open towards the right than the left ventricle, a right auricle dilated, a left contracted, a right ventricle thickened in its walls, a left proportionally thinned. This child lived only five months, was healthy for the first month, from which period, although she sucked well, there was a sensible diminution of her strength, and she finally became very much emaciated. She was most easy in the usual position of sucking. If placed erect, or whenever she cried or coughed, her skin, in proportion to the degree of exertion, became darker: a change always attended with a complete loss of voluntary power. A day or two preceding her death, she had screaming fits, so violent, as to threaten suffocation, after which she did not breathe so freely as usual. No notice of the ordinary state of her respiration is taken, and her temperature is not mentioned.

For the purpose of illustrating, by a figure, this variety of malformation, combined with other varieties, hitherto esteemed remarkable, I shall, for the present, close this part of my inquiry with the following case.

A female infant, four weeks old, was brought to me at the London Dispensary, Artillery Street, in the month of April, 1809. The colour of her skin was blue, and as often as she cried, which happened whenever she was moved, the colour became very dark. Being well clothed, her skin was of a good warmth; but her mother assured me that she chilled fast, and that it was very difficult to keep her warm. Her respiration was short, but not very laborious. The umbilicus was ulcerated, and the surrounding integuments were inflamed. Under one of her arms, an ulceration of the skin, tending to gangrene, had taken place. The functions of the alimentary canal were badly performed, and her feeble powers were wasted by a diarrhœa. She lived only a week longer.

Through the influence of Mr. Weston, who kindly assisted me, I obtained leave to examine this subject. The septum ventriculorum was perforated, the aorta arose from both ventricles, and was dilated; the pulmonary artery was imperforate, as far as its bifurcation, and its branches received their blood from the aorta through the ductus arteriosus. The right auricle and ventricle were larger than the left.

Fig. 13. *a.* The pulmonary artery impervious, except at its division into its right and left branches, which are supplied with blood in a retrograde course from the aorta through the ductus arteriosus.

b. The ductus arteriosus enlarged.

c. The septum ventriculorum largely perforated. A quill is passed from the right into the left ventricle, through the aperture in the septum.

d. The aorta, which is enlarged as far as the ductus arteriosus, arises over the aperture in the septum, but chiefly from the right ventricle. Bristles, passed from the aorta into the ventricles, shew the communication between both these cavities and that artery.

I. 2. *i.* *Transposition of the Aorta and Pulmonary Artery.*

This remarkable variety of malformation was first described by Dr. Baillie in his Morbid Anatomy, and figured in his engravings.

The subject of it was an infant, who lived two months. The skin was most unusually livid, the surface of the body colder than that of a child properly formed and in good health; but the respiration was natural.

The heart was of the common size, the aorta arose out of the right ventricle, and the pulmonary artery out of the left. There was no communication between the one vessel and the other, except through the small remains of the ductus arteriosus, which was just large enough to admit a crow quill. The foramen ovale was a little more closed than in a child newly born.

The next observation on this variety was communicated by Mr. Langstaff, in vol. iv. of the London Medical Review. A well-proportioned male infant had, immediately after birth, a dark purple colour of the face, and a brownish black hue on every part of his body. Though the weather was extremely warm, and he was wrapt in flannel, his temperature was much lower than that of a child six weeks old in the same room. For three weeks he had only a slight difficulty of breathing, except when he sucked; but it gradually increased till it amounted to symptoms of dyspnœa, during which the skin became still darker, and the temperature lower. At the age of ten weeks, in one of these paroxysms, he died suddenly. The pulse was remarkably languid and small, sometimes obscure, and the bowels were disordered.

The right auricle was so much distended as to be nearly equal in size to the rest of the heart, the right ventricle was natural, except that the aorta arose from it. The left ventricle, as thin in its parietes as the right, had a smaller cavity, and gave origin to the pulmonary artery, which communi-

cated freely with the aorta by the ductus arteriosus, the size of which was proportionate to that of the other vessels.

The following case affords a third example of the transposition of the arteries. A male infant, the eleventh of Mrs. B.'s children,* appeared at his birth to have been well nourished. As soon as he was born, he began to cough so violently that his mother was alarmed for his safety. He lived five months, during which period she remarked the following circumstances: a difficulty in his breathing, which prevented him from sucking with the same ease that her former children had done; a considerable pulsation at the pit of his stomach; a remarkable blueness and excessive coldness of his skin; a frequent recurrence of the cough, which was aggravated by any change of posture, except to his right side. She was compelled to keep him constantly wrapped in flannel. The slightest exposure, even of one of his hands, or of a part of his face, would cause him to shiver. He seemed to be only easy when lying on his right side, with a sufficient accumulation of heat to produce perspiration. At the age of two or three months he had several fits, which were relieved by putting him into warm water; a diarrhœa, to which he was subject, was kept in check by a cordial medicine. When he was five months old, his sister, now the only survivor of the eleven children, was attacked with small-pox—he received the infection; the eruptive fever manifested itself by an increase of heat only about the head, the body and extremities remaining cold. When the pustules began to appear on the face and body he was seized with a fit. No benefit resulted from putting him into warm water, and he soon afterwards expired. He had refused the breast for the two preceding days.

This malformation consisted in a transposition of the arteries, the auricles and veins being correctly situated. The aorta, and its ventricle, marked by its muscularity and figure, constituted the right portion of the heart; the pulmonary artery and its ventricle the left. The pulmonary artery branched correctly, and the origin of the ductus arteriosus is preserved;† but unfortunately its connexion with the aorta was dissevered by the manner in which the latter was truncated. This artery was too small to admit the rounded extremity of a common probe. The foramen ovale was imperfectly closed, the valve being cribriform, but the foramina were minute. The lungs had a natural appearance, the pleuræ had contracted no adhesions, and contained no fluid. The skin, after death, changed to a copper colour, with minute spots of a brighter red, marking the incipient small-pox pustules.

† *Fig.* 14. c. The superior cava.

* Six of these children were still-born at the full period.

† This figure as well as 13. 3. 2. and 1. are magnified.

Fig. 14. *b. b.* The auricles.

c. c. The ventricles altered in their figure; but some allowance must be made for both ventricles being cut open posteriorly, and stretched to display their structure. The ventricles themselves can be said to be transposed only in respect to their figure, and the relative thickness of their walls; for the right valve is tricuspidal, and the left mitral. It seemed unnecessary to add another figure to illustrate these facts.

d. The aorta arising out of the right ventricle.

e. The left pulmonary veins.

f. The pulmonary artery, coming from the left ventricle, and dividing into its right and left branches.

g. The ductus arteriosus cut off close to the pulmonary artery by the hasty manner in which the aorta was truncated. A perfect representation of this variety may be seen in Dr. Baillie's work. This figure has been added, to shew the much diminished canal of the ductus arteriosus, and the dilated state of the pulmonary artery. From the former, it will be manifest, that life may be maintained for some time, by a very inconsiderable stream of red blood. From the latter, it will appear, that small as were the foramina in the valve of the foramen ovale, yet more blood passed through them into the left cavities of the heart than could be compensated by the quantity which the ductus arteriosus carried into the general circulation. In this child black blood, with the exception of the very small proportion of red blood, conveyed into the aorta by the narrowed ductus arteriosus, was perpetually circulated not only through the right cavities of the heart, but every part of the body, except the lungs; and red blood was always circulating through the branches of the pulmonary artery, and veins, and the left cavities of the heart, except the small quantity of black blood which escaped into the latter through the cribriform valve of the foramen ovale.

It will not be doubted that other varieties of the imperfect double heart exist. Mr. J. Bell has described one in which both the pulmonary artery and aorta arise from a middle or third ventricle. The right and left ventricles are in every other respect correctly formed, and receive their blood from their auricles in the usual way, but deliver it into the third ventricle. This approaches the variety, I. 2. *h*.

Mr. Lawrence, at the same time that he shewed me the singular specimen before mentioned, which corresponds with Mr J. Bell's case, in the addition of a new part, or third ventricle, was also so obliging as to point out to me another, in which the venæ cavæ and pulmonary veins open, as they usually do, into their respective auricles, but the septum auricularum is very imperfect, consisting only of a small muscular band, which leaves a large foramen ovale without a valve; the septum ventriculorum is altogether want-

Fig. 13.

Fig. 14.

ing, so that the ventricle communicates with both auricles by a single ostium ventriculi, around which a valve is attached: the aorta and pulmonary artery, the entrance of the latter being somewhat contracted, arise side by side from the left part of the ventricle. Specimens of the single heart, I. 1, *a*, *b*, *c*, have already been given. Next to these we have, in this case, an example of the most simple human heart which the anatomist has yet discovered. Although it be difficult to find a place for it under any arrangement, yet it must be classed amongst the imperfect double hearts. The partial septum auricularum, the appendix to each auricle, but more particularly the distinct origin of a pulmonary artery, as well as of an aorta, plainly prove that the formative effort was directed to the structure of a double heart. In I. 1. there is no evidence from the structure that the formation of a double heart had been attempted. The single auricle has but *one appendix*, and from the single ventricle only one artery arises. The history of the above case is unknown, but from the size of the heart, it is probable that the child lived some months.

Thus far, however, it is ascertained that the imperfect double heart differs less in function than in form from the single heart. In all the examples which have been given, black and red blood were mingled. This circumstance has engrossed the attention both of the physiologist and pathologist, to the exclusion of one that is not less important, namely, the difficulty with which the circulation is generally performed by a malformed heart.

A configuration which impedes the circulation of the blood in any degree, affords in itself a source of increasing difficulty. Those who have patiently watched the slow organic changes of this viscus, which are independent of malformation, must surely be convinced of this fact. I am far from disregarding the evils which result from mingled black and red blood. I wish only to discriminate between two very different trains of symptoms, and to trace them to their respective sources.

1. *A permanent blue colour of the skin.*—The blue approaches to a black colour in proportion to the diminished size of the pulmonary artery, and of the ductus arteriosus. It affords a sign of the first species of malformation of the heart, or that which mingles black with red blood, being present in a very large proportion of these cases; but it has already been proved, that malformation may exist although this sign be not present. See I. 1. *a*. and *c*. Another exception occurs in the second example of the variety, I. 2. *d*. The patient's skin was always very pallid. From these exceptions, we learn, that if the *full* proportion of blood be circulated through the lungs, although the red blood be subsequently mixed with an equal proportion of black blood in the heart, yet a black colour will not be imparted to the skin. This fact, at present, applies

only to the infant. Evidence is wanting to prove its application to the youthful and the adult state.

In difficult transmission of blood through the heart, or its vessels, especially its pulmonary branches, the skin is pallid, transiently livid, of a violet colour, or permanently blue, according as its capillary vessels are more or less completely filled, but chiefly in proportion as the circulation is retarded through the lungs. The same effects are produced by whatever diminishes the capacity of the air cells in a remarkable degree. It is certain, however, that the peculiar blue colour of the skin, which has even given a name to those who have malformed hearts, is far more characteristic of mingled black and red blood, the former being in excess, than it is of an impeded circulation, and constitutes the most material part of the diagnosis.

2. *Coldness of the Skin.*—This sign naturally follows the blue colour of the skin, as both are produced by an over proportion of black blood. It may be worth the trouble of reconciling the contradictory evidence respecting this sign, by tracing the variation in the structure, by which the difference of temperature may be justly explained. If the reader will examine *d.* and *e.* in figure 3, and compare them with *b.* and *g.* in figures 12, 13, 14, he will perceive that signs of a diminished temperature at the surface of the body were manifested in proportion as the pulmonary artery, or, in the event of the obliteration of that artery, the ductus arteriosus, diminished in size; and that it was sensibly least in the example in which the ductus arteriosus was smallest. If, in I. 1. *b.* and in the second example of I. 2. *f.* the observations, respecting the external temperature of the body be correct, it would appear that there is an over propoction of black blood, which gives the first sign—a permanent blue colour, without manifesting, in the infant state, the second sign—a coldness of the skin. Although this observation needs farther proof, it is certain, that a still greater excess in the proportion of black blood, as in some of the cases above referred to, affords both signs in a striking degree. The evidence of this fact will also be found in all the examples of I. 2. *i.*

3. *Paroxysms of irregular respiration—of screaming—of panting. Respiration, remarkably quick—continually difficult or laborious—sense of suffocation—cough.* The disturbed state of the breathing by paroxysms, seems to be more characteristic of mingled black and red blood; but the dyspnœa, of difficult transmission of blood through the heart and its great vessels.

4. *Palpitation—vehement action of the heart—pulse irregular, quick, and weak—intermittent. Serous effusion* into the cavities and cellular membrane, manifested by œdematous legs and bloated face. *Hemorrhages* from the

nose, gums, lungs, &c. These signs, varying in degree, and more or less combined, are found in many cases of malformation, and are indicative only of an impeded circulation.

5. *Torpor of the Brain—Epilepsy—Apoplexy—Paralysis—Syncope.*—— These effects are to be attributed partly to an impeded circulation through the heart, to the accumulation of blood in the brain, and the consequent pressure sustained by that organ, and partly to the want of those renovating powers which red blood may impart to the brain.

6. *Defective Nutrition.* This effect varies in degree from the slender to the emaciated figure, according to the condition of the alimentary canal and its dependent organs; for in some there is too little appetite; in others, too much—in some, constipation; in others, diarrhæa.. But if the natural functions be tolerably well performed, and the due proportion of chyle absorbed, it is not unreasonable to expect an accumulation of adipose matter in a subject whose circulation is disturbed or impeded, whose blood cannot always warm the surface of his body, and whose nervous system is without energy. Such was the actual condition of the boy whose case was recorded by Dr. Richard Pulteney, and whose figure must have been the reverse of that which Dr. Hunter, in a peculiar, but forcible manner, thus described: "If a man had never seen any of the canine species but the bull-dog, for example, he would be much struck at the first sight of the slender and delicate Italian greyhound. This young gentleman's figure put me in mind of that animal; and when I looked upon his legs particularly, I could not but think of the limbs of a wading water-fowl."

The *almost sudden* extinction of life in man and other warm-blooded animals, by the various accidents which suspend respiration, is not fully explained by saying, that the source of heat is cut off, and the excretion of a matter deleterious to the system is interrupted. Other circumstances contribute to that event, the most important of which, it is probable, remains unknown; but there is one, which, without insisting too strongly on its importance, is yet very worthy of being noticed, because it may serve to guide our judgment in cases of malformation of the heart, where the diagnosis becomes more than usually difficult. I mean the association which exists between the action of the heart, and the action of the muscles of respiration. The suspension of the latter must materially derange the former. But these associated motions are reciprocal, so that any remarkable imperfection in the functions of the heart will also be generally attended with a disordered respiration: thus, in I. 1. *a.* and in the third case of I. 2. *c.* in which neither a blue colour, nor a coldness of the skin, were remarkable, the peculiarities of their respiration marked the malformation of their hearts.

Finally, on the subject of mingled black and red blood, it is expedient to

direct the attention of the profession to the following desiderata:——1st, The accurate measurement, by the thermometer, of the *internal* and external temperature of the patients. The former may be done by placing the bulb of the thermometer under the tongue, or, more conveniently in infants, by introducing it into the rectum, as Dr. Baillie long ago suggested. In the cases which have already been communicated to the profession, as well as in some of those which are here added, we have, as it were, with one consent, neglected this important experiment. In one instance, however, of a lady, whose skin suddenly became and remained permanently blue, from a lesion, as it was supposed, of the septum of the heart, Mr. Astley Cooper ascertained that her internal temperature was 100 degrees, whilst her extremities were sensibly colder than natural. This interesting observation supports the result of the experimental inquiry on this point by Mr. Coleman, which he published in his valuable work on suspended respiration, and invites farther investigation. 2dly, The quantity of carbonic acid gas which may be formed by the subject of a malformed heart, during successive acts of respiration in a determined period, compared with the quantity formed by a perfect subject of like age and figure. This experiment will be far more difficult than the former, and its result must be more dubious; but if it can be made with any tolerable approximation to the truth, it is expected that it will furnish an interesting fact, especially in those patients whose skins are permanently blue and easily chilled.

A delay in printing this sheet having occurred, I am enabled to add, in this place, some observations respecting the temperature of subjects with malformed hearts. I shall give them as they occur in the cases to which they respectively belong. For the first case, I am indebted to Mr. Travers, who has kindly extracted it from his note-book. It is an example of the variety, I. 2. *h*.

H. B. visited 4th August, 1809, Æt. 14. Tall of his age, but very spare and weakly from an infant. Light brown hair, full dark eyes, broad alæ nasi, and broad projecting under-lip, slit in the middle, or fissured. Tongue too large for his mouth, and jagged upon its surface; its edges looked as if cut; gums spongy, breath peculiarly fœtid. Little muscular flesh on his arms and legs, lean and long fingers and toes, clubbed or bulbous at the ends, and large nails. Skin remarkably sleek, but always bedewed with perspirable matter; everywhere of a uniform and unchanging deep livid hue, approaching to purple. Mouth habitually a little open, and head sunken, or carried low between the shoulders. Health delicate, but pretty even—very susceptible of cold. Respiration difficult on moderate exertion—frequent catching of breath, and yawning. Hard cough, brought on by running, or going quick up stairs. Deep, but regular, beat of the heart in a

state of rest—palpitation, or vehement action of heart, produced by continued exertion. Pulse, at the wrist, 80—regular; but weak, and easily accelerated. Complains occasionally of tight and cutting pain round the chest, and of a burning sensation about his ancles, in bed. Often starts in sleep, and wakes with a sense of suffocation. Lies with his head high. Appetite moderate—generally thirsty. Often feels chilly in the hottest weather. Good tempered, even spirits, but slow intellect. He often whistles loud and strong, but with intervals—cannot read out long together. His sight is rather dim; more so latterly. The conjunctiva becomes quickly bloodshot on exercise. Animal heat 2° higher on the interior than at the surface of the body.

On Saturday, 20th Feb., died suddenly, of copious hemorrhage from the lungs. He had of late been much distressed with increased cough, nausea, and extreme debility.

Examination next day—Sunday evening, 21st Feb. 1810. Remarkably prominent sternum—very oblique ribs, left side a little bulged. Vast quantity of fluid blood on right side of the heart—all the blood fluid, except a fibrous clot in the foramen ovale—intestines dark colored—liver also, more dark than natural on the surface. Lacteals filled with chyle, having just breakfasted before death. Heart large in its body, particularly the right ventricle; its parietes as thick as the left. Pulmonary artery contracted to less than half its size, would not admit the little finger. Left auricle very small—left ventricle also small. Aorta larger than common; large opening at the top of the septum of the ventricles, which was deficient to appearance. No communication between the arteries—ductus arteriosus obliterated. Valve of the foramen ovale imperfect at bottom: opening, when stretched, of the size of a writing quill. Firm, but partial adhesions of the pleuræ—lungs greatly diseased—tubercles—ulcerated cavities in them, containing grumous blood; largest on the left side. These had not the appearance of vomicæ pulmonum: they contained no pus, nor had there ever been purulent expectoration.

I regret that, in the experiment on H. B., the actual degree of his internal temperature was not noted. The following cases enable us to compare the external with the internal temperature, and to form a probable opinion, that the latter is really higher in these subjects than in those who have perfect hearts, whilst the latter is contingent on external circumstances.

On the 14th of July, 1814, Mr Hodgson favoured me with an opportunity of observing a blue child, Charles Bowman, aged five years. The bulb of a *common* thermometer, being held for a considerable time in one of his hands, closed, the mercury rose only to 85°. The same thermometer held by myself, for a much shorter time, rose to 98°. The bulb of the same instrument, being placed under his tongue, and, subsequently, under my own,

the mercury, in each experiment, remained steadily at 98°. The temperature of the room was 63°. On the 20th of the same month, I repeated the experiment with a very delicate thermometer, made by Jones, solely for the purpose of measuring animal heat. The bulb of the instrument being inclosed in his hand, about the space of ten minutes, the mercury rose to 98°, and remained at that degree; but, on being placed under his tongue, and his lips closed, it presently rose to 99°. The temperature of the room was 66°. The circulation was rather feeble in this child; the pulsations of the heart were felt over the whole of the left side of the thorax, and the pulse at the wrist was 120. His breathing, always hurried, was somewhat laborious and noisy, and was occasionally assisted by a deep inspiration. It was said, that he coughed much on motion, and then complained of pain at the pit of his stomach. His countenance was suffused, and his complexion inclined to purple: his skin, universally, was rather dark. The last phalanges of the fingers were much spread, and the nails were purple. It was stated that in the summer his hands were often warm and damp; but in the winter always cold; or, to use his mother's expression, they felt like ice. His size is rather small; he was lusty, but is now very thin, and is rapidly reduced by slight causes. This boy has always appeared to his mother to be weaker than her other children. From his birth, he was incapable of bearing brisk motion, and he cannot now bear any exercise, even as well as he could do at the age of three years—he presently complains of weakness in his knees, and pain in his legs. His tongue is clean, but of a purple colour; his appetite is stated to be irregular; his bowels, in general, regular, but sometimes painful, and yielding offensive matters, which are always darker than natural: his urine high coloured, and depositing a red sediment. Pain at the pit of his stomach, of which he complains more frequently than usual, caused him to scream last night; and, on the night before, he had a vertiginous attack. He occasionally catches hold of the nearest object to him, and says that the room turns round with him. With regard to his mind, it is said that he is quick in learning, and that his memory is very retentive; but his temper is fretful; and if opposed, he coughs violently, turns black, and seems in danger of dying. When agitated by passion, he bends himself forward, and supports the pit of his stomach. His natural disposition is playful, and he would indulge it if he could; but if he merely runs across the room, he seems ready to fall.

Soon after I last saw this boy, the vertigo increased, and caused him very frequently to scream; but, on sending him into the country for several weeks, and discontinuing the use of moderate doses of diluted sulphuric acid, which he was at that time taking, the vertigo ceased, and has not since returned. Yesterday, August 22, after moving more briskly than usual twice across the

room, during which effort he had nearly fallen, he was seized with vomiting and a fit of coughing, which lasted for a considerable time. If he is allowed to move at his usual pace, which is very slow, he can walk for some time without producing these distressing effects. His mother remarks, that his nose, chin, fingers, and toes, are more sensible of injury than in other children. Slight pressure or blows on them give him great pain. He finds comfort in washing his hands in warm water, which he frequently expresses a wish to do.—Sept. 30. The use of a gentle tonic has restored his appetite, which was defective, and improved his general health. To-day he begins to complain of pain in his bowels, which affection much distressed him during the last winter. The following table gives at one view the sum of my observations on him, since the 20th of July.

Date.	Temperature, of external air,	of room,	of hand,	of foot,	under tongue,	Pulse.	Resp.
Aug. 23.	—.	70.	98.	97.	99.	108.	28.
Sept. 13.	52.	59.	74.		99.	96.	32.
—— 17.	61.	69.	96.		99.	100.	28.
—— 23.	60.	65.			99.		29.
—— 30.	58.	61.	92.		99.	100.	31.

On the 23d of August, and 13th of September, the internal temperature was a fraction above 99°. But the former being a warm, and the latter a cold day, there was a marked difference in the temperature of the external surface; for, in ten minutes, the mercury rising very slowly, was only 74° in the hand; whilst under the tongue, in three minutes, it a little exceeded 99°. On the 17th and 30th of September, the internal heat did not exceed 99°, and on the 23d, it barely reached that degree. The observation having been interrupted on that day is not complete. No pains have been spared to give accuracy to the above table; but, in so young a subject, it is not an easy matter to make it perfect. This series of observations will be continued, without attempting, at present, to extend the inquiry to the changes induced on atmospheric air by his respiration, from the impracticability of obtaining, at his age, results sufficiently accurate.

On the 21st of July, 1814, I visited, with Mr. Leadam, J. W., æt. 22 years. I found him sleeping on his right side, and profusely perspiring. His figure was diminutive, and his appearance puerile. His face was of a deep violet colour; his features were tumid and disgusting, and, in their conformation, resembled more the African than the European. His body and hands were as warm as natural; but his feet were cold. He presently awoke, and appeared somewhat alarmed. His tongue, of a deep purple colour, and very unequal surface, was yet clean and moist. His appetite had been good, but was now defective. His bowels were stated to be regular, and the matters evacuated of a natural appearance, except during the last winter, when

some blood was discharged, without any relief of his symptoms. His urine was reported to be high coloured, offensive, and scanty. In proportion to his heighth, the size of his abdomen and the capacity of his thorax were large. His respiration was easy, but rather quicker than natural; and, with a certain regularity, he occasionally took a deep inspiration with perfect freedom. His muscular power was so much reduced, that he was no longer able to walk. Whilst he was capable of taking exercise, to which till lately he had been equal, slight exertions sufficed to bring on dyspnœa and cough; and under much motion, the muscles, concerned in respiration, laboured exceedingly. The pulsations of his heart were too plainly felt over a large surface of the left side of the thorax. At every action of the heart, the external jugulars were observed to swell: his pulse was rather more frequent than natural; but neither irregular, nor intermittent. The colour of his skin was very dark, and the superficial veins were enlarged and varicose: the latter was apparent even on the eye-lids, and the conjunctivæ partook of the general discoloration. A certain silkiness of skin was noticed, his fingers excepted, which were rough, with warty excrescences, and more than usually clubbed at their extremities. He occasionally suffered pain in his lower extremities, and his ancles were œdematous. His head was sometimes affected with vertigo. His eyes were prominent and suffused, the pupils slowly contracted on exposure to light; but his vision was perfect. There was no apparent defect in the other senses.

On taking out of my pocket a thermometer to measure his temperature, he began to weep. This affection was to be referred partly to a sense of his situation, but partly also to fear; for he was very timid. His mind, like his body, was childish; but in no respect fatuitous. To reconcile him to the experiment, I began by taking his external temperature, and requested him only to hold the thermometer. The mercury slowly rose to 98°, and remained at that degree. On putting the bulb of the instrument under his tongue, and closing his lips, the mercury rapidly rose to 100° and a fraction. The temperature of the room was 76°. The bulb of the same thermometer, being put under my own tongue, the mercury was observed, by Mr. Leadam, to stand at 98°; but, on being replaced under the tongue of the boy, it again rose between two and three degrees above animal heat, from which it did not vary, although we observed it for some time.

In this case, the black blood in circulation being so remarkably in excess, I thought it very desirable to ascertain the proportion of carbonic acid, formed in a certain quantity of atmospheric air expired by him, compared with that formed in the same quantity expired by any other individual of perfect structure. Unprovided with apparatus for the purpose, I applied to a philosopher, whose accurate experiments have already added to our know-

ledge of the changes produced on atmospheric air and oxygen, by the function of respiration. As this gentleman declared himself zealous to pursue this new link in the chain of his inquiry, I arranged the time for the experiment; but his apparatus being then incomplete, I waited his appointment. In the mean time, that the inquiry might be conducted with greater precision, Mr. Leadam, at my request, kindly undertook to note daily, in the form of a table, the relative number of respirations and pulsations in a minute. I regret to add, that the opportunity of ascertaining the changes produced on those gases by his respiration, was lost, during this delay, by the death of the youth, which happened on the 3d of August.

The following observations were made, by Mr. Leadam, between the period of my seeing him, and the day of his death. The nearer he approached his end, the greater impatience and irritability of temper he manifested. His hands were sometimes sufficiently warm; at others, much colder to the touch than natural. The profuse sweating which was observed on the 21st of July, continued, in a greater or less degree, for two or three days, and then ceased. At that time the œdema of the lower extremities nearly disappeared, and did not subsequently increase. He died rather suddenly, after taking a fuller meal than usual. The following table will shew the state of his pulse and breathing, with the respective dates of observation.

July	26.	Pulse	114.	Respiration	29.
——	27.	——	100.	——	28.
——	28.	——	108.	——	29.
——	30.	——	120.	——	29.
August	2.	——	100.	——	26.

On the 4th of August, the body was examined by Mr. Hodgson; and Mr. Leadam obligingly included me in the number of his medical friends who were present on that occasion.

External appearances. The skin in general, the face being excepted, was less dark than during his life. The thorax and abdomen were rather large; but the extremities were slender. The length of the subject, from the vertex to the heel, was four feet three inches. The circumference of the lower or expanded part of the chest, twenty-seven inches—of the upper part of the chest, under the axillæ, twenty-three inches. All the characters of puberty were wanting. A partial discoloration of the integuments of one of the great toes, extending some way on the top of the foot in a continued line, was remarked. It had the appearance which precedes slow gangrene. A few days previous to his death, he had complained of great pain in that part.

Thorax. By a universal adhesion of the pleuræ, the thoracic viscera were united in one mass, with the exception of the reflected portion of the Pericardium. The lungs were free from tubercles; their cellular texture was coloured with blood. The right cavities of the heart, the venæ cavæ, the subclavian and jugular veins, were charged with an unusual quantity of black fluid blood. The following particulars respecting the heart and its vessels, were worthy of remark. The veins were perfect, excepting the inferior cava and the coronary vein, which were dilated. The Eustachian valve was larger than usual. The size of each auricle was proper. The valve of the foramen ovale, although imperfectly closed, was still capable of performing its function. The ostia ventriculorum were narrowed—the right admitted the points of two fingers—the left, the point of only one finger. The tricuspidal valve was attached to two fleshy columns, the mitral only to one, which was also situated in the right ventricle—thus both the auricles opened into the right ventricle, which was not only more capacious, but thicker in its walls than natural. The pulmonary artery, instead of its usual seat, arose from the superior and *central* part of this ventricle, by a very narrow mouth of dense structure. Its semilunar valves were nearly concealed by a warty excrescence,* which grew from them, leaving a passage, in its centre, barely large enough to admit a small probe. The rest of the pulmonary artery was of its proper size. The septum ventriculorum was wanting; and instead of the left ventricle, a pouch, impervious towards the left auricle, was continued from the right ventricle, and opened, anteriorly, into the aorta by a free orifice. The ductus arteriosus was closed. The left vertebral artery arose from the aorta, between the left subclavian and left carotid.

If circumstances had permitted an examination into the structure of this heart at the time of opening the body, the appearances would have led to an inquiry respecting the size of the bronchial arteries. It may, however, be stated, from a subsequent examination of the portion of *descending* aorta, removed with the heart, that no branch, remarkable for its size, appeared as low as the *fifth* intercostal.

Abdomen. The quantity of serous fluid in the peritoneum was inconsiderable: it did not exceed an ounce. All the viscera were of a deep claret colour. The liver was gorged with blood, and rather gibbous. The spleen was more than twice its natural size. Sections of those viscera, and of the

* This case is by no means calculated to support M. Corvisart's opinion respecting the source of these excrescences—" dont la nature serait tout-à-fait inconnue, si une ressemblance parfaite avec les crêtes et les choux-fleurs vénériens, et quelques rapprochemens faits d'après un certain nombre d'observations, ne conduisaient à penser que leur nature pourrait être syphilitique."
Corvisart, sur les Maladies du Cœur, p. 217.

kidneys, presented a dark and mottled appearance, usual in cases in which the transmission of blood through the heart has been impeded. The mesenteric glands were not at all enlarged, and their internal structure appeared natural. The mucous, like the peritoneal coat of the stomach, was universally of a dark colour. It contained some undigested food.

In this case, the trunk of the pulmonary artery and its branches were not sensibly reduced in their size, although the entrance of the artery was so remarkably straitened. At first view, this seems to form an exception to that law of the arterial system, by which an artery contracts in proportion as its contents are diminished, until it is finally reduced to an impervious filament. But on comparing the termination with the beginning of the pulmonary circulation, the former, as well as the latter, was much impeded; for, not to mention the excessive constriction of the left ostium ventriculi, all the tendinous cords of the mitral valve were inserted into *one* fleshy column, by which the valve was constantly nearly closed, and farther subjected to considerable pressure by its position in the right ventricle, which not only received all the blood, but performed all the labour of the system. The blood being so much impeded in its passage into the ventricle, the pulmonary system might be filled, even by the minute stream which was admitted into the pulmonary artery. The size of this artery may be explained by these circumstances. A still greater difficulty, however, presents itself, respecting the temperature of this boy; for the stream of blood, which fed the pulmonary artery, being, in this case, so very small, how could a sufficient quantity of caloric, in its specific form, be combined with it, to preserve a sensible temperature of, at least, one hundred degrees on the internal surfaces of his body. There seems to be sufficient evidence that the function of respiration is a source of animal heat. But I am free to confess my opinion, that it is not its only source. Priestley's celebrated experiment proved, that black blood could be converted into red blood, without the actual contact of air, or the structure of lungs. In like manner, although the lungs may be best adapted to perfect the changes which produce animal heat, it is sufficiently probable that this important operation does not exclusively belong to them.

The fact that this boy's internal temperature amounted to one hundred degrees, is in confirmation of the opinion that black blood differs in its capacity for heat from red blood; but if the former, on the internal surfaces, be capable of taking on a higher temperature, by two degrees, than the latter; it is also certain, that on the external, it is much more easily deprived of its heat, by the various circumstances which favour the reduction of animal temperature—So that, the latter, being able to retain its temperature longer than the former, must hold, in combination, an extra proportion of caloric.

I have already attempted to reconcile the contradictory evidence respecting

the symptom of coldness of the skin, by proving that its manifestation bears some proportion to the diminution of the pulmonary circulation. The last observation shews farther, that the coldness is regulated by external circumstances.—That under those which favour the accumulation of animal heat, the thermometer at the skin rises as high in such a subject, as in one of perfect structure; but that the heat is more slowly accumulated, and, under contrary circumstances, more rapidly expended. From this view we perceive that a hasty observer, guided only by his sense of touch, on feeling the skin of a blue child when exposed, would report it to be colder than natural; whilst another, making his observation on a similar subject, well covered and favourably situated for the accumulation of heat, would report the temperature of his skin to be as warm as natural.

II. Malformations of the Heart, or of its Arteries, only impeding the Circulation of the Blood.

II. a. *Left Ostium Ventriculi Contracted, and Mitral Valve Rigid.*

These important parts of the heart are so remarkably changed by chronic inflammation, that the judgment, which assigns such appearances, even in young subjects, to malformation, rather than to disease, may be questioned. As a species of malformation, it has been described, I believe, only by Mr. Allan Burns, and from the opinion of so good an anatomist it retains its place, till farther evidence shall decide whether it be, or be not, improperly placed among the malformations.

Four cases of this species (the sixth species of Mr. Burns), were published in his work on the diseases of the heart. His second case, which affords the most probable example of it, occurred in an extremely delicate female, who, from her birth, had been subject to pectoral complaints, syncope, and darkness of the surface; and from the age of 17 to 19 years, to irregular action of the heart and dropsy. The accumulation of fluid in the abdomen was excessive, and the operation of paracentesis was performed six times. She experienced, especially after exertion, a throbbing sensation in the epigastric region. On examination only a slight undulating motion was discovered while the abdomen was tense; but, after the fluid had been removed, a swelling could be felt in the upper part of the belly, and by the violence of its pulsation, the integuments were alternately elevated and depressed to a very considerable extent. The pulse was frequent, fluttering, and often inter-

mittent. She died at the age of nineteen, without any material alteration in the affection of the heart; except what was denoted by the increasing uneasiness from its violent pulsation.

The heart was very unequally dilated. The right auricle was as large as a child's head of a year old, and filled with clots of blood. The venæ cavæ were much dilated: the inferior cava admitted with ease four fingers. The ostium ventriculi equalled in size the inferior cava. The tricuspidal valve was rigid, and in some places ossified. The ventricle seemed rather less than the auricle. The left auricle was extremely small. Instead of the left ostium ventriculi, a rigid septum, in some spots ossified, separated the auricle from the ventricle. It was perforated at its centre by a puckered aperture, of a size just sufficient to admit the tip of a little finger. The flaps of the mitral valve, which arose as usual, were stiff, and in some spots loaded with calcareous matter. The columnæ carneæ and chordæ tendineæ were healthy. The ventricle was also small, but proportionally thicker and stronger than usual. The aorta, at its origin, and through its whole course, was exceedingly small. In the cavities of the chest and pericardium a very few ounces of serum were found.

II. b. *Ostium Aortæ Narrowed by having Two instead of Three Semilunar Valves.*

Dr. Baillie notices this variety as being very uncommon. It is represented in his engravings, plate 2. fig. 5. from Mr. Hunter's museum; but I find no account of the case in his Morbid Anatomy, 8vo. edit. The following observation affords an instance of this rare malformation.

Mrs. ———, aged 24, a delicate woman, of the middle size, eight months married, in the eighth month of her pregnancy, died suddenly on Wednesday morning, the 27th of May, 1812. Mr. Saner, who resided on the spot, instantly attended. He found her countenance suffused and very livid, but she was already dead. On the 28th, twenty hours after her death, Mr. Saner favoured me with the opportunity of conducting the dissection, which was done with the assistance of himself and Mr. J. Burrows.

The brain minutely examined, presented only the natural appearances. The longitudinal and lateral sinuses of the dura mater were rather more turgid with fluid blood than they usually are.

The heart had the parietes of its left ventricle much thickened, and the valves of its aorta malformed. Two, instead of three semilunar valves, had

been formed, and these were so united as to constitute one membrane, having an oval aperture in its centre. Ossific matter was deposited on the surface of the valve next to the ventricle. A moderate quantity of serum, tinged with red particles, was found on both sides of the chest. The lungs were sound.

The viscera of the abdomen were in a natural state. The uterus had contracted just below the umbilicus: to its internal surface the placenta and membranes yet adhered. The fœtus had been turned and extracted by Mr. Saner immediately after the mother's death. Although this humane effort to preserve its life, was not crowned with success, the circumstances of the case being unfavourable, yet the attempt merits praise. Such an effort is not incompatible even with a trial of means for restoring animation to the mother. The Cæsarian section, for the preservation of the infant, ought only to be used when the mother has suffered a violent death.

I was informed, by her husband, that he had been acquainted with her only twelve months previous to their marriage. During that period she could never bear quick motion. Since marriage, he had observed, besides a difficulty in her breathing, frequent palpitation: he could even hear her heart beat as he lay beside her. The dyspnœa had so much increased during her pregnancy, that at night he had been obliged to carry her up-stairs to bed. Mr. Smartt informed me that he had attended her for symptoms of pneumonia, a few months before her death; but he did not, at that time, remark any peculiarity in her pulse.

Fig. 11. Represents a section of the aorta near its malformed valve. The eminences, which appear behind the oval aperture in the valve, shew the situation of some of the ossific depositions. On comparing it with *fig.* 12. the same variety of malformation will be seen in the pulmonary artery. The latter also illustrates the combination of both species of malformation in the same subject, of which several other examples may be found among the cases under I. 1. and 2.

In concluding the first species, some remarks were offered on the different train of symptoms which belongs to each. I am less inclined to a farther pursuit of this subject, as it respects the second species; because a more ample field of inquiry into the signs of difficult transmission of blood through the heart, will be afforded me by investigating the effects of acute and chronic inflammation on this important organ.

The subject of malformation of the heart promises to be more fruitful to physiology than to pathology; but to the latter it is not wholly barren. The *cure* of disease is certainly a pleasant part of the duty of a physician or surgeon. He who, on sufficient evidence, is convinced that he has been the instrument of rescuing from death, and restoring to health a human being,

feels that he has performed a service which is beyond all recompense. On the contrary, although it be a painful duty to watch over incurable disease, yet is that a most consolatory and acceptable service to the patient, which is employed in diminishing his sufferings. Even on this almost hopeless subject, it is not enough to say in the words of the justly celebrated Dr. Hunter. —"Though the cure of diseases be the first object of our profession, the knowledge of incurable complaints is of much importance to humanity; particularly in restraining us from bleeding, blistering, vomiting, purging, cutting issues, applying caustics: in a word, torturing a miserable and incurable human creature."—It is not enough to refrain from inflicting pain where there can be no compensation for it, we must sooth and mitigate the evil which nature does not, and art cannot cure.

In the subjects of malformed hearts, the distress is in proportion to the diminished quantity of red blood which enters the general circulation, or simply to the mechanical impediment which opposes the transmission of the blood, or to both conjoined. We propose at present, shortly to consider the means of mitigating the first; but to reserve the second, for the reason above assigned, in postponing the farther inquiry into the signs of difficult transmission of blood through the heart.

It is worthy of observation, to what a minute stream the red blood is reduced by some of the peculiarities of structure, which have already been described. It is obvious, that in such cases, this important change, which it belongs to the function of respiration to work, is very imperfectly accomplished. From this consideration two questions arise:

1st. Is there any other organ by aid of which the imperfect changes of the respiratory function may be, in a degree, compensated? The skin seems to be that organ. In the preceding histories there is sufficient evidence, that not only bodily suffering was much diminished, but life was actually prolonged by the frequent use of the warm bath. Either as physiologists, or as pathologists, we are very far from having developed the important functions of the skin. The subject demands, and will reward, our research. It is not sufficient in these cases, by clothing the skin in flannel, to retard the expenditure of the imperfect quantity of heat that is generated by the system; we must *impart* heat to the skin, invite blood into its capillary vessels, by the soothing medium of warm water, and compensate for the unfinished sanguification in the lungs, by changing, as far as it can be done, the blood at the surface of the body. It is by the management of the skin, and the regulation of its temperature, that we may relieve many of the disorders of respiration; it is partly by the management of the skin that we may hope, in this variable climate, to rescue many of the delicate, and often most regretted victims of phthisis. From the palpable benefit which follows, even

in the most aggravated paroxysms peculiar to these subjects of malformation, the use of the warm bath, it is probable that their comfort may be materially promoted by living in an atmosphere so regulated in its temperatnre, as to prevent that chilled state of the skin, which must disable it from compensating in any degree for the imperfect function of respiration.

2dly. Can any thing be done in these cases to favour the influx of red blood into the aortic system? It is probable that it may, in some cases, be assisted by the position of the patient.

In the variety I. 2. *h.* there are two examples of the important relief obtained by an attention to posture, especially in moments of the greatest danger to the patient. In Mr. Abernethy's case, although the child was little more than two years' old, the evidence of this fact was very striking. During the paroxysm, the skin, which, from his earliest infancy, had been remarked to have a darker tinge than common, *became unusually blue.* A coldness which was so habitual, as to induce his parents always to clothe him in flannel, was *much increased.* The child seemed to suffer much uneasiness about his chest, and showed a wish to be laid with *his face downward;* if this were not immediately complied with, *he contrived to turn himself to that posture.* After the paroxysm was over, the colour of his skin, which had become livid in proportion to the severity of the paroxysm, improved. This change was sufficiently remarkable; for it is expressly stated, that his lips, which at all other times were blue, *acquired a reddish tint,* which lasted for an hour or two. In Dr. Hunter's case, the evidence of the benefit of posture is still more satisfactory. The youth had been taught by experience *altogether to prevent,* or at least, to diminish the violence of a paroxysm, by instantly lying down *on his left side,* and remaining in that position for about ten minutes. In the third case of the variety I. 2. *i.* the infant seemed to be only easy when lying *on his right side.*

The actions of the heart are remarkably disturbed by the condition of the alimentary canal. An inattention to this fact is one fruitful source of a false diagnosis and prognosis respecting supposed organic diseases of the heart. But if the sympathy between these organs be such, that irregular actions of the heart may be thus excited, although its structure be perfect; it is very probable that they may be produced in a still greater degree, where it is actually malformed. The distress of these unhappy patients may be mitigated by attention to the kind and quantity of food taken into the stomach and by regulating any deficiency or excess in the evacuations from the intestines only by the mildest remedies in our possession.

END OF ESSAY I.

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